

HORIZONTAL MACHINING CENTER

KH-4500

OPERATION MANUAL

KIWA MACHINERY CO., LTD.

(22-02)

PREFACE

We appreciate your selection of our horizontal machining center this machine. This machine allows high precision positioning, linear cutting and continuous circular cutting. This machine has been developed for milling, boring, drilling, reaming, tapping, etc.

This manual provides essential information and instruction necessary for its operation/maintenance.

Please read this manual carefully and thoroughly prior to operation/maintenance of this machine to ensure safety, efficiency and reliable performance for years of operation.

Also, please refer to FANUC's manuals for information concerning programming and automatic operation, etc.

IMPORTANT

This machine has been manufactured and shipped in accordance with the laws and regulations of the country/area first destined. Therefore it is prohibited to export, resell or relocate the machine to other countries/areas.

Moreover, this machine falls in the category of Controlled Products by Japan's Foreign Exchange and Trade Law. Please make sure to contact us or Kiwa's distributor for export, resale or relocation of the machine, including its move from where it is to another place.

KIWA MACHINERY CO., LTD.
522-51 Harade Kuramochi-cho,
Nabari, Mie 518-0752 JAPAN

PREFACE

NEVER OPERATE THE MACHINE WITHOUT READING THIS OPERATION MANUAL CAREFULLY. BEFORE HANDLING, YOU MUST UNDERSTAND THE SAFETY PROVISION, AND FUNCTIONS OF THIS MACHINE. BE SURE TO KEEP THIS MANUAL NEAR AT HAND.

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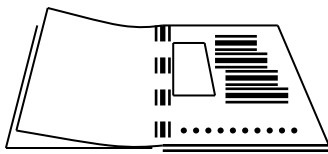
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SAFETY PRECAUTIONS

SAFETY PRECAUTIONS

1. For safety operation

To ensure proper and appropriate machine operation, follow the fundamental instructions as below.



Carefully read this instruction manual and make sure you understand the contents.

This instruction manual describes correct procedures of operation. Read this manual before operating the machine, and fully understand the contents. Never attempt to use the machine in any way not described in this manual.

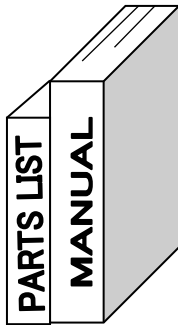
KIWA shall not be responsible for any direct, incidental or consequential damage on person or property if you misuse or use the machine without understanding this instruction manual.

Only personnel trained for operation are authorized to handle the machine.

The machine must be handled only by personnel trained for its proper operation and handling with ample knowledge and authorized by your supervisor. Prescribe a qualification system in your in-shop regulations.

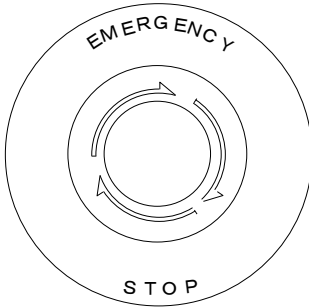
KIWA shall not be responsible for any direct, incidental or consequential damage on person or property if operators ignorant about its operation and proper practices use the machine.

SAFETY PRECAUTIONS



Always place this instruction manual near the machine.

Keep this instruction manual safely in a designated place of easy access so that you can read it any time necessary. Choose a person to be in charge of keeping it. If any manual is damaged or missing, relay the machine model name and the serial number to your local distributor. A new one will be supplied at your own cost.



All personnel must be aware of the location of EMERGENCY STOP buttons.

All personnel must know the location of EMERGENCY STOP buttons and how to use them in case of emergency. Decide on emergency action to be taken in case any personnel except an operator presses an EMERGENCY STOP button.

Never use air blow for cleaning inside machine cover.

For cleaning of cutting chips attached on the covers after machining, never use air blow. If chips enter the inside of machine, especially under the sliding covers, it may deteriorate machine accuracy and result in machine troubles.

SAFETY PRECAUTIONS

2. Hazardous areas

High voltage area:

(Hazardous areas where opening the cover and touching the devices inside the cover will result in a serious personal injury or death from electric shock.)

- Electric box
- Operation panel
- Coolant pumps
- Lubrication pump
- Motors
- Terminal boxes

[Never touch inside these devices. Only qualified electricians with official licenses are authorized to touch inside these devices.]

Machine movable area

- Movable area of spindle head, column, and rotary table
- Movable area of ATC
- Movable area of APC
- Spindle
- Chip conveyer (option)



The chip conveyer may start moving suddenly depending on specification. Be sure to turn the main machine off before carrying out maintenance work on the chip conveyer.

- Spindle cooling unit (option)

[Always keep away from these hazardous areas during automatic operation. Otherwise, turn off the main power correctly by the specified procedure when entering these areas for the purpose of maintenance or other reasons.]

SAFETY PRECAUTIONS

3. Protective safety devices

To protect you from accidents as much as reasonably possible, protective safety devices are provided in the machine. Understand these functions before operating the machine.



WARNING

- Never damage, remove or relocate any part of the protective safety devices without KIWA's permission. Doing so could result in serious personal injury.
- Before operating the machine, check that all protective safety devices work properly. If not, immediately contact your local distributor.

List of Protective Safety Devices

NAME	LOCATION	REMARKS
EMERGENCY STOP buttons	on the machine (Machine operation panel) (Machine left-hand side) (Pallet set-up side)	
Main power switch	on the electric box	
Door safety lock	Work set-up doors Operator side door ATC magazine door	
Key	Electric box	
Alarm messages	LCD	

SAFETY PRECAUTIONS

4. Safety Labels

The following warning labels and an instruction plate are attached to the machine. If any label is damaged or becomes illegible, contact your local distributor, immediately. A new one will be supplied at your own cost.



Never remove or disfigure any warning label or instruction plate.

Labels and Plates

- 1) Safety Instruction Plate
- 2) Lightning Mark (Triangle)
- 3) Danger Label (Electric Shock)
- 4) Warning Label (Door)
- 5) Warning Label (Pinch Points)
- 6) Manufacturer Plate

1)

SAFETY INSTRUCTIONS

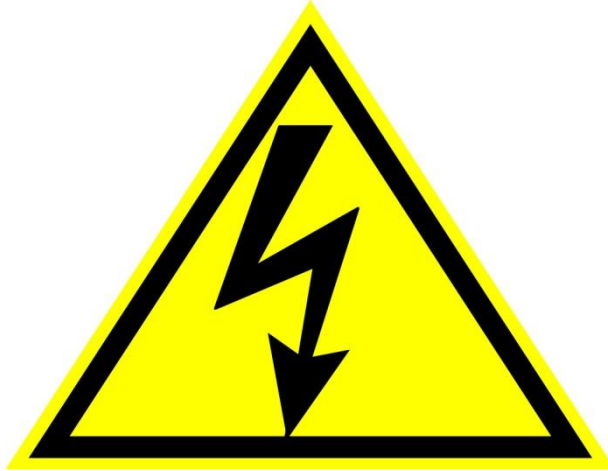
- 1. Only personnel trained for operation or maintenance can handle machine.**
- 2. Read manuals before operating machine. Follow instructions.**
- 3. Always follow instructions written on safety labels.**
- 4. Be aware of location of Emergency Stop pushbuttons.**
- 5. Use water-soluble coolant to prevent fire during unmanned operation.**
- 6. Shut machine off when checking or servicing.**
- 7. Do not operate machine with maintenance covers removed.**

Failure to follow the above could result in serious injury or machine damage.



KIWA MACHINERY CO., LTD.

SAFETY PRECAUTIONS

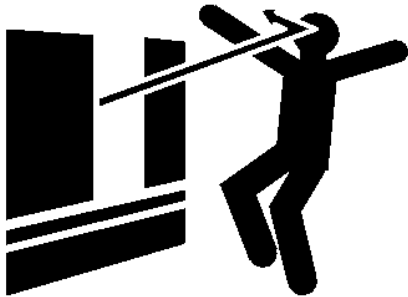

2)



3)

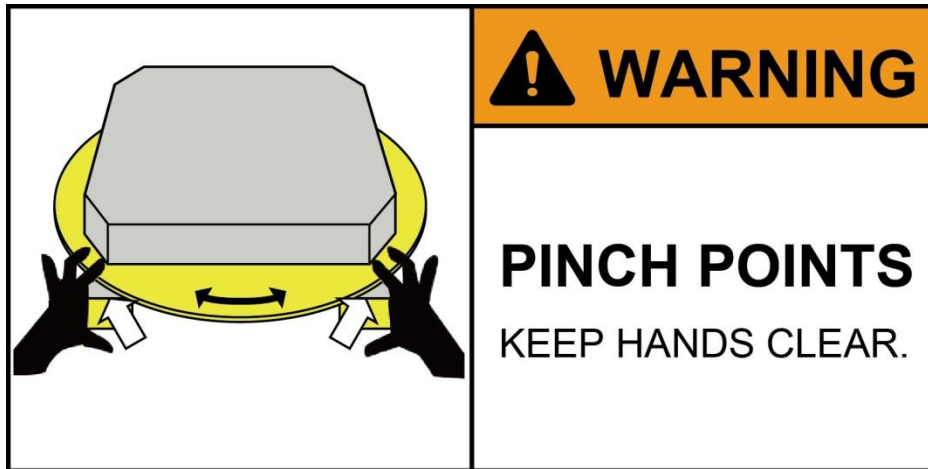
	<div> DANGER</div> <p>Shut power off before opening door/cover.</p> <p>Failure to do so could result in serious injury or death.</p> <p>Never touch inside soon after shutting breaker off.</p>
--	--

4)

	<div> WARNING</div> <p>Always shut doors/ covers during operation.</p> <p>Shut power off for servicing inside doors/ covers.</p>
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SAFETY PRECAUTIONS

5)



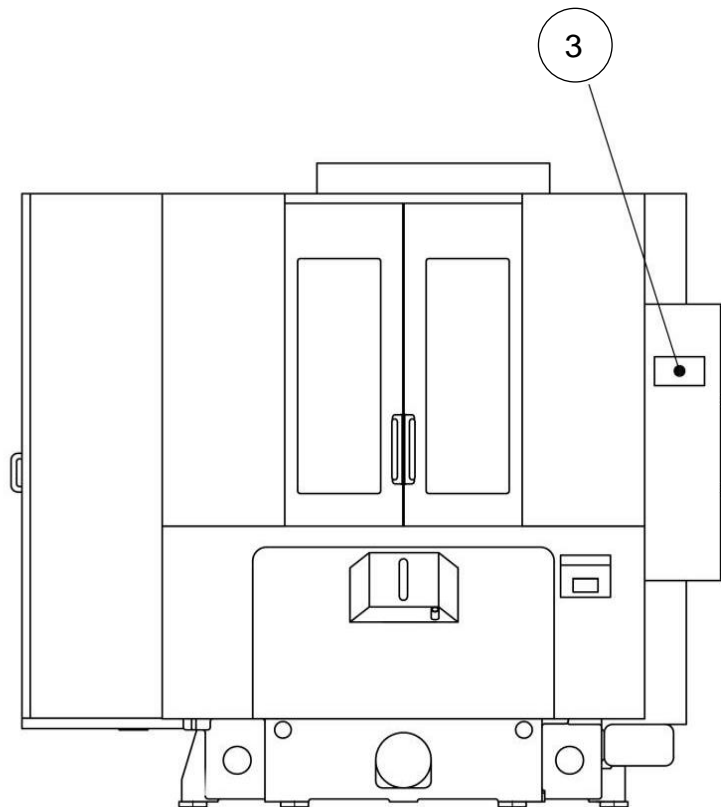
6)

⊕ MACHINING CENTER ⊕	
MODEL	<input type="text"/>
SERIAL NO.	<input type="text"/>
ELECTRIC VOLTAGE, PHASE, FREQUENCY: AC 200V, 3 ϕ , 50/60Hz	
REQUIRED ELECTRIC CAPACITY	<input type="text"/> KVA
MAX. INPUT ELECTRIC CURRENT	<input type="text"/> A
SHORT CIRCUIT CURRENT OF MAIN BREAKER	<input type="text"/> KA
ELECTRIC DIAGRAM NO.	<input type="text"/>
MASS (MACHINE ONLY)	<input type="text"/> KG
YEAR OF MANUFACTURE	<input type="text" value="20"/>
KIWA MACHINERY CO., LTD.	
MADE IN JAPAN	

SAFETY PRECAUTIONS

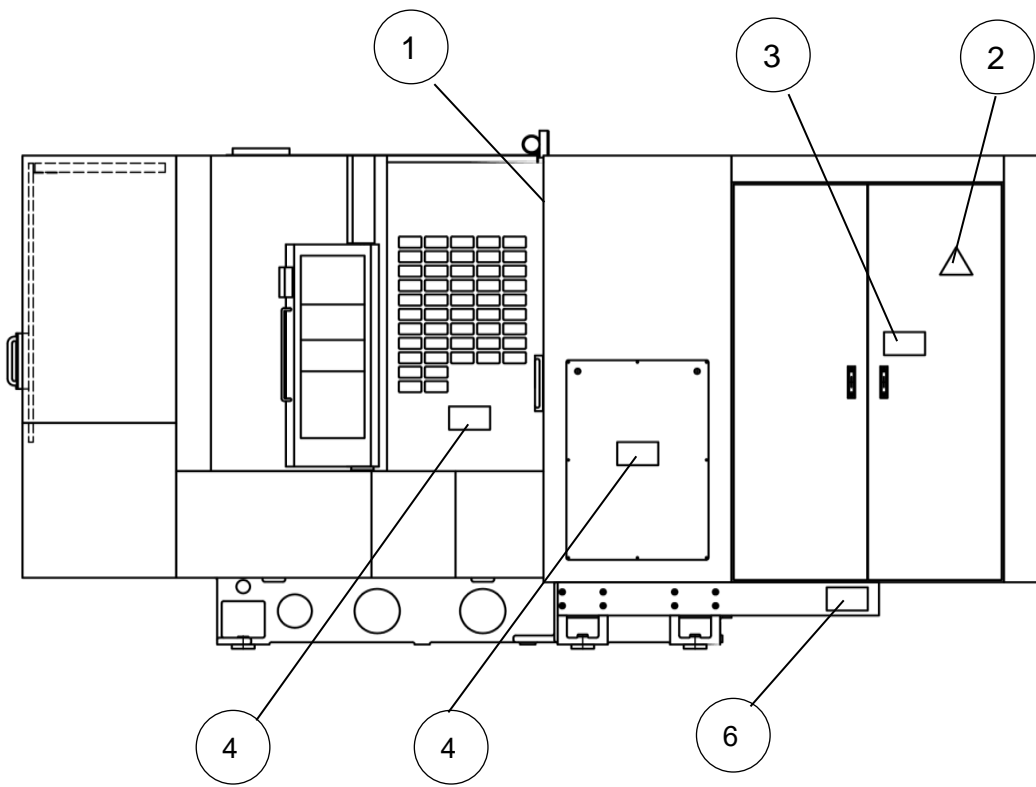
Labels and Instruction for safety are fixed as below:

- 1) Safety Instruction Plate
- 2) Lightning Mark (Triangle)
- 3) Danger Label (Electric Shock)
- 4) Warning Label (Door)
- 5) Warning Label (Pinch Points)
- 6) Manufacturer Plate

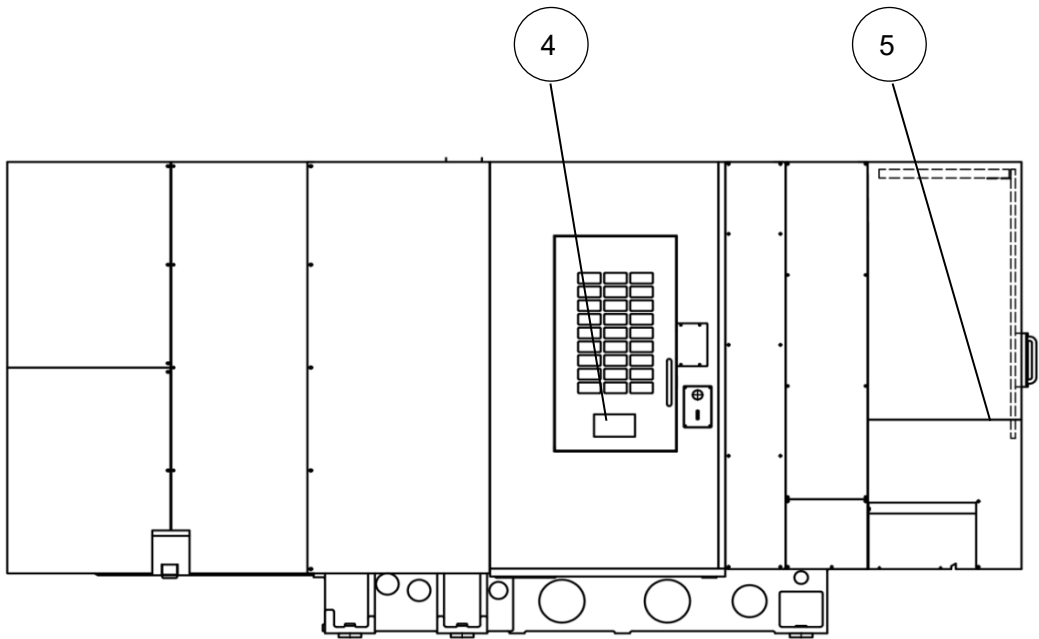


[Machine Front side]

SAFETY PRECAUTIONS

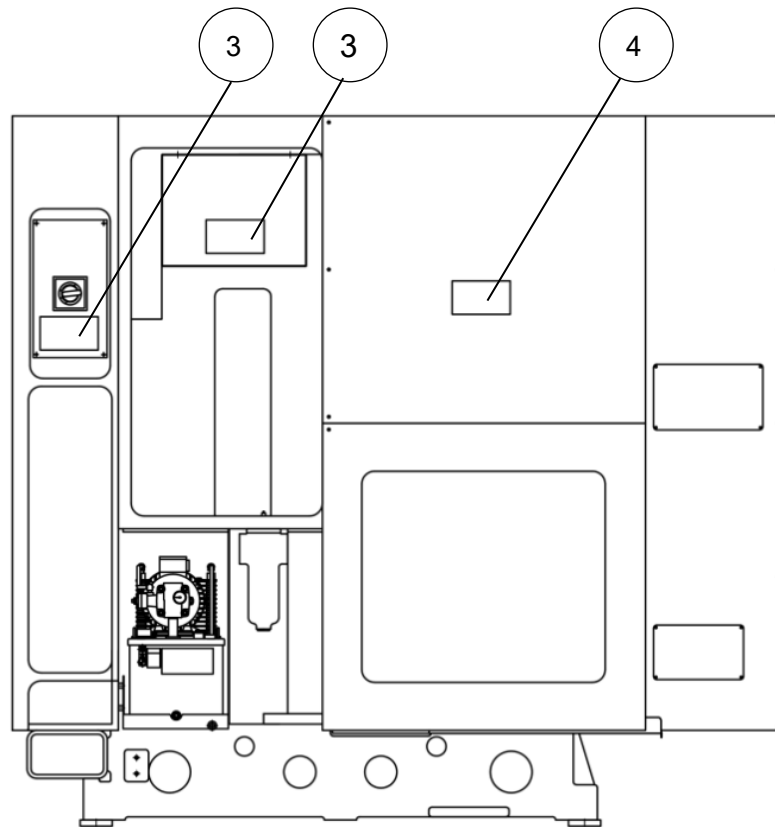


[Machine Right side]

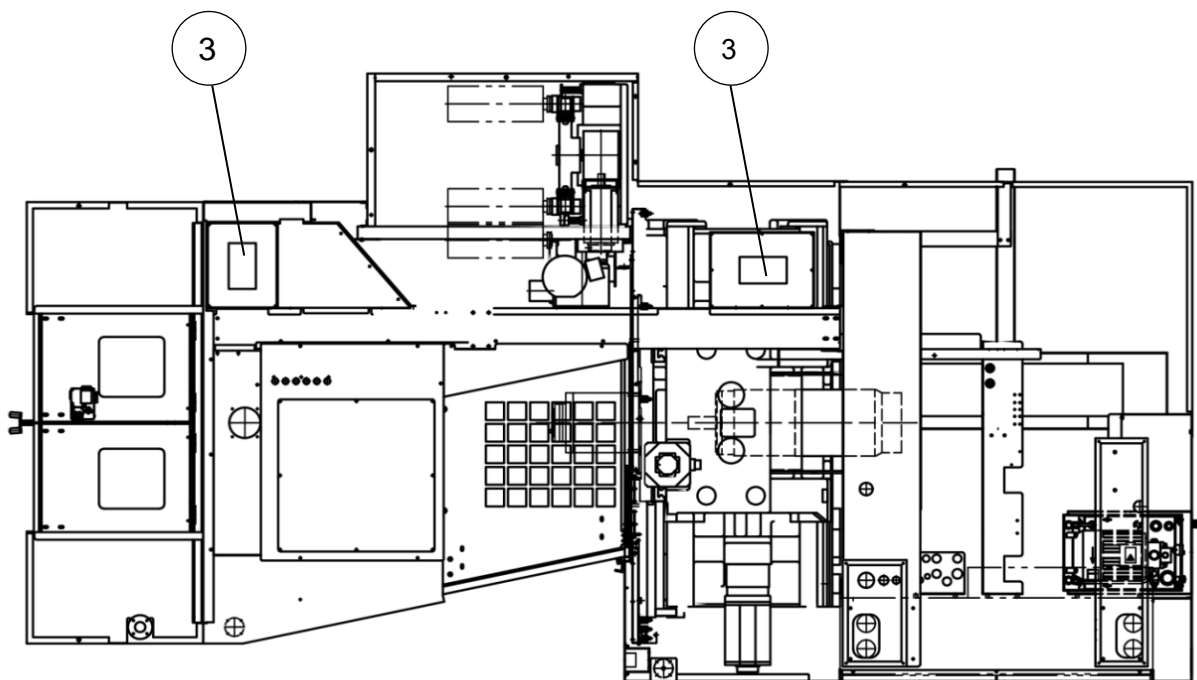


[Machine Left side]

SAFETY PRECAUTIONS



[Machine Rear side]



[Machine Top]

SAFETY PRECAUTIONS

5. Check points before operation



WARNING

Cable and wire with damaged film can cause electric leakage or shock. Please check that there is no damage on cable and wire. Failure to observe this warning will result in a serious personal injury or death by electric shock.

Please check the following points for safety before operation.

CHECK POINTS	CHECK ITEM	METHOD	REMARKS
Lubrication tank	Lubrication oil sufficient?	Check visually.	
Coolant unit	Coolant sufficient? No chips accumulated?	Check visually.	
Slide cover	No chips accumulated?	Check visually.	
Table	No chips accumulated?	Check visually.	
Spindle	Spindle bore clean?	Check visually.	
ATC	No chips nor coolant attached? No tools worn out? No chips on tools?	Check visually.	
Electric box	Doors closed? No damage or disconnection on external wiring or cable?	Check visually.	
General	Machine environment well sorted out? No looseness of bolts on cover, etc.?	Check visually.	

SAFETY PRECAUTIONS

6. Safety Instructions

Safety Instructions are classified into the following three levels. They are subject to the seriousness of possible hazard to personnel or properties. Always note the instructions, in particular, these of high seriousness.



Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.



Addresses practices not related to personal injury.

SAFETY PRECAUTIONS

7. Remarks on operation

- 1) Read carefully and follow strictly the instructions given in this manual.
- 2) Make sure that all doors are closed when turning power on machine. The NC will not get ready if the doors are not closed properly.
- 3) High voltage is applied inside the electric box. Shut off the factory power source before opening its doors. Remember that input wiring to the main switch is powered even when the main switch of the machine is turned off.
- 4) Before running a new program in Automatic mode, execute it with Single block to check the program contents and to check that there is no interference between movable parts.
- 5) Check the clamping condition and the arrangement of cutting tools.
- 6) Make sure that the coolant nozzles are directed to the workpieces.
- 7) Be sure to perform the required procedure before resuming the automatic operation when it was stopped halfway. Or restart the program from the very beginning.
- 8) Do not touch the switches and buttons on the operation panel inadvertently during automatic operation.
- 9) Manipulate switches and buttons correctly and firmly.
- 10) Function and operations not described "possible" in this manual must be considered as "impossible" and must not be carried out.
- 11) Never touch the spindle or the tool while the spindle is rotating.
- 12) Be sure to wait for the spindle to stop completely before attempting to remove chips from the tool.

SAFETY PRECAUTIONS

- 13) Possible danger always exists during cutting operation that coolant, chips or broken tool tip may be thrown out of the machine. To avoid potential hazards, keep a proper distance from the machine.
- 14) Never attempt to clean or inspect the machine while in operation. Be sure to bring it to a complete stop before cleaning or inspection.
- 15) Never machine materials harmful to body.
- 16) Never use coolant fluid harmful to body.

SAFETY PRECAUTIONS

8. Warnings and Instructions

1) General



- Never touch any switch, key or button with wet hand.



- Never remove or modify any protective components and/or interlocks without the maker's permission.
- Never modify the machine in any way which may decrease the safety of the machine.
- Turn off the main switch at a power failure.
- If intense lightning or frequent power failure takes place, stop the operation to prevent accidents by voltage fluctuation.



- Never operate the machine unless you understand all functions of operation switches and corresponding machine motions.
- Double check the switches or keys you are going to operate.
- To avoid accidental activation of switches or keys, never touch them involuntarily or lean against the machine.
- Secure generous working space around the machine and remove obstructions in operation.
- To prevent accidents by slipping, always keep the floor dry. Ensure that floor is free from oil or water.
- The work table for tools or workpieces must be of sufficient strength and equipped with a non-slip device.
- Flammable workpieces or liquid must be stored in a place away from the working space, satisfying all national and local safety and health requirements.
- Never handle coolant liquid with bare hands.

SAFETY PRECAUTIONS









CAUTION

- Never allow the operation panel and control box to be subject to impact.
- Neatly arrange the tools and workpieces and obey the following instructions.
- Place them securely where there is no possibility of them falling off.
- If the tools or workpieces must be placed in a vertical position or leaned against anything, take appropriate measures to prevent them from falling down.
- If the tools or workpieces are piled up, take appropriate measures to prevent them from falling.
- Never operate the machine if affected by alcohol, drugs or other substances or conditions which decrease alertness of judgement.
- Always wear a hard hat, safety shoes, safety glasses (goggles) for performing maintenance and servicing.
- Never wear a ring, bracelet, wrist watch, or loose-fitting clothing which may be caught in the machine or workpieces.
- Neatly bundle long hair and wear a protective cap to prevent accident by being involved in the machine.
- Every operation, maintenance, and cleaning must be done in maximum safety condition by using safety clothing (check the next table).

SAFETY PRECAUTIONS

Safety Clothing

Title	Symbol	Description
Helmet		Helmet must be used in case of machine installation in place with risk of falling object.
Gloves		Gloves must be used in case of work with material with spike or cutting edge, oil, coolant, workpiece with dirt or oil or coolant, chips, and so on. Gloves must not be used when working on CNC keyboard or operator panel.
Safety Shoes		Safety shoes must always be used.
Work Clothes		Work clothes must always be used.
Safety Glasses		Safety glasses must be used when using air or coolant gun.
Ear Protector		Ear protector must be used when working with air gun or when it is requested due to the acoustic condition of work place.

SAFETY PRECAUTIONS

2) Power ON/OFF



DANGER

- Cable and wire with damaged film can cause electric leakage or shock. Double-check that there is no damage on cable and wire. If any, ask qualified electricians for corrective actions.



WARNING

- Always obey the turning power on/off instructions described in this Operation Manual.
- Check that protective components and interlock systems are functioning properly. If any trouble, ask the qualified maintenance personnel to take corrective actions or contact your local distributor immediately.
- All guards must be in place without damage.
- Check the following points after turning the power on.
 - No alarm is indicated on the screen.
 - Pneumatic pressure is appropriate.
 - No abnormal sound is heard from the motors or geared sections.
 - The cooling fans in the electric box are turning.
 - The spindle and sliding parts are lubricated properly.
- Perform the daily check-ups listed in the Maintenance Manual.
- When the machine is to be operated after a long interval, check that the motions, sound and lubrication condition on the sliding parts have no trouble. If you suspect a trouble, shut the power off and ask the qualified maintenance personnel to take correct actions.

SAFETY PRECAUTIONS

3) Warming-up



CAUTION

- Warm up the machine after turning the power on.
- Warm up the spindle according to the procedure labeled on the machine.
- The program for warming-up should include activating all the possible machine motions.

SAFETY PRECAUTIONS

4) Setting-up



WARNING

- Only qualified personnel are authorized to carry out hoisting, or to use cranes or forklifts. Never put yourself under a raised object in any event.



CAUTION

- Heavy items exceeding 20 kgs must be handled by an appropriate lifting unit, or by two or more personnel.
- Use wire rope or sling of sufficient capacity without disconnection, distortion, corrosion or kink.
- Use pull studs of the specified type. Check that the pull studs are not loose before starting daily operation.
- Cutting tools wrongly mounted or with chipped edge can cause accidents. Replace them appropriately.
- Check that workpieces are securely mounted on fixtures and tools are securely clamped in the spindle.
- When loosening/tightening bolts, be careful not to lose balance, which may result in touching the machine unexpectedly or falling down.
- Always wear leather gloves for set-ups or cleaning.
- Use tools with the length and diameter which do not interfere with the fixtures.
- Before mounting tool holders to the spindle or ATC tool pot, wipe off the spindle taper or the tool gripping sections of the tool pots with clean cloths.
- Use a special tool removal jig for removing the tool holder from the tool pot.
- Never leave the tools or instruments used for set-up operation in the machine. Put them away in the specified storage space.

SAFETY PRECAUTIONS

5) Automatic Operation



WARNING

- Never damage, remove or relocate any part of protective components or interlock systems of this machine. Never operate the machine with any high-voltage terminal exposed.
- Never touch any moving units nor rotating units during machine operation.
- Never enter machine movable area during machine operation. Before approaching these hazardous areas for maintenance or set-up purposes, shut the machine off securely using the correct procedures.
- Always obey the following instructions during operation. When the following work is to be done, stop the machine in the designated procedures.
- Never adjust the coolant nozzle direction during spindle rotation.
- Never remove chips from the tools or any other places during spindle rotation.
- Do not try to tighten bolts on workpieces or measure them during operation of the machine.
- Never remove chips from the table or workpieces or clean them during operation of the machine.
- Before removing the machined workpieces, check that the automatic operation is completely stopped, confirming Cycle Start lamp and Feed Hold lamp are off.
- Always shut the doors of splash guard for automatic operation. Never open any covers or doors of the machine during automatic operation.
- Before operating the machine, check that the area in which the machine parts move is empty and that there is no obstruction in machine motion.
- If the machine stops abruptly during automatic operation, never resume operation before the

SAFETY PRECAUTIONS



WARNING

trouble is located and resetting procedures are understood. Resuming operation without knowing the reason of stoppage is dangerous.



CAUTION

- Never touch any switch, key or button with gloves on.
- Never leave any tool, cutting tip or measuring instrument on the machine covers during operation.
- Never touch switches or keys involuntarily or lean against the machine during automatic operation.
- Before starting automatic operation for the first time, check that the program is correct and that all the switches, such as dry run, override, coolant, etc. are correctly set.
- Dispose of chips regularly. Never let them pile up in the machine.
- Understand the characteristics of the materials being processed.
- Never remove chips from tool tips with bare hands. Wear gloves and use a brush for the removal.
- Stop the machine and contact your supervisor if you suspect a malfunction.
- If an alarm message is displayed, immediately contact qualified maintenance personnel.
- To prevent fire, obey the following instructions for un-manned operation at night or when the operator has to be away from the machine for a long time.
 - Use non-flammable water-soluble coolant. If flammable oil is definitely required, use one of high flash point (above 160°C) and supply a large amount (2 lit./min.) of coolant to the cutting point.
 - When machining inflammable workpieces or using inflammable coolant fluid, equip the machine with some danger-preventive device

SAFETY PRECAUTIONS



CAUTION

- to prevent/alert fires.
- Check that lubricant and coolant are sufficiently supplied and that these units are properly working.
- Check the condition of tool tips, cutting conditions, cycle time and tool life.
- Never place flammable items, such as wooden blocks, paper, cloth, oil, gas, etc., around the machine.
- Adjust the nozzle direction so that coolant is properly poured to the tool tip.
- If a heap of chips prevents coolant from flushing to the tool tip, use several nozzles or attach a special nozzle to flush out chips.
- Never weld or do other work which makes sparks near the machine.
- Never mix flammable items, such as cloth, matches or cigarette butt, in chips.
- Never smoke around the machine.
- To protect the machine, obey the following instructions.
 - Before attempting axial movement, check that tools or the spindle head does not interfere with workpieces or jig.
 - Before resetting the machine in an emergency stop state, completely remove cause of the trouble.
 - When a program operation is to be executed for the first time, do not execute it continuously in the automatic mode. Check the programmed motions and their safety one by one, using the single block switch.

SAFETY PRECAUTIONS

6) Closing-down



WARNING

- For cleaning the machine or peripheral equipment, such as chip conveyor (optional), etc., stop all the machine motions correctly and shut off the machine.



CAUTION

- Never clean the machine using an air gun. Blown chips may hurt human body.
- Wear gloves for removing chips, etc.
- The solenoid valves remain hot for a while after power is turned off. Be careful not to burn your hands.
- To prevent any foreign matter from getting into the spindle, attach a dummy tool to the spindle if not in use.

A. MACHINE COMPOSITION

A. MACHINE COMPOSITION

This machine consists of the following parts:

- Machine body
- Numerical control system
- Electric box
- Pneumatic unit
- Hydraulic unit

The machine is controlled by the numerical control system. The X, Y, Z, B axes and ATC magazine are all driven by servo motors through ballscrew or gears. Spindle revolution is given by a spindle motor directly, or optionally by a built-in motor. The speed is programmed with 5-digit S code. Tool selection is commanded by the 4-digit T code*. All other commands such as coolant pump start, etc. are processed by using miscellaneous functions in the numerical control system.

* When Tool life management function (option) is used, Tool selection is commanded by 3 digit T code. [Ref. FANUC Operation manual]

B. OUTLINE OF MACHINE

B. OUTLINE OF MACHINE

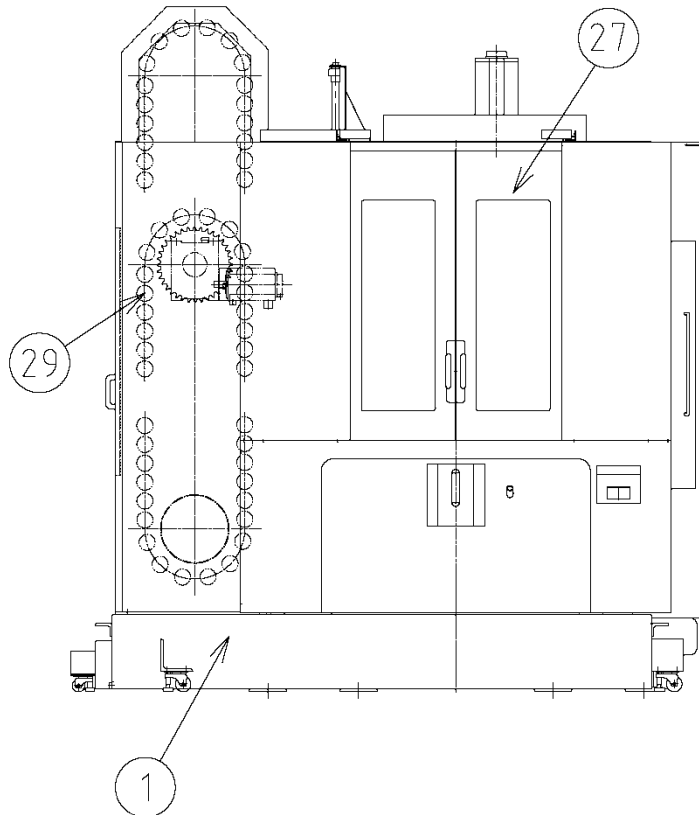
B-1 Description of Machine

No.	Description
1	Coolant tank
2	Lubrication unit
3	X-axis servo motor
4	Pallet
5	Rotary table
6	Operator side door
7	Spindle
8	Y-axis servo motor
9	Spindle head
10	Tool unclamp cylinder
11	Electric box
12	Column
13	Hydraulic unit
14	Bed
15	Z-axis telescopic cover (column side)
16	Spindle motor
17	Z-axis telescopic cover (APC side)
18	Z-axis servo motor
19	CNC operation panel
20	Machine operation panel
21	Tool clamp/unclamp switch (2 places)
22	Manual pulse generator
23	ATC magazine door
24	ATC operation panel
25	Single arm operation panel (only 80/120ATC)
26	Servo motor for magazine rotation
27	Front (set-up) doors
28	ATC unit
29	Tool pot

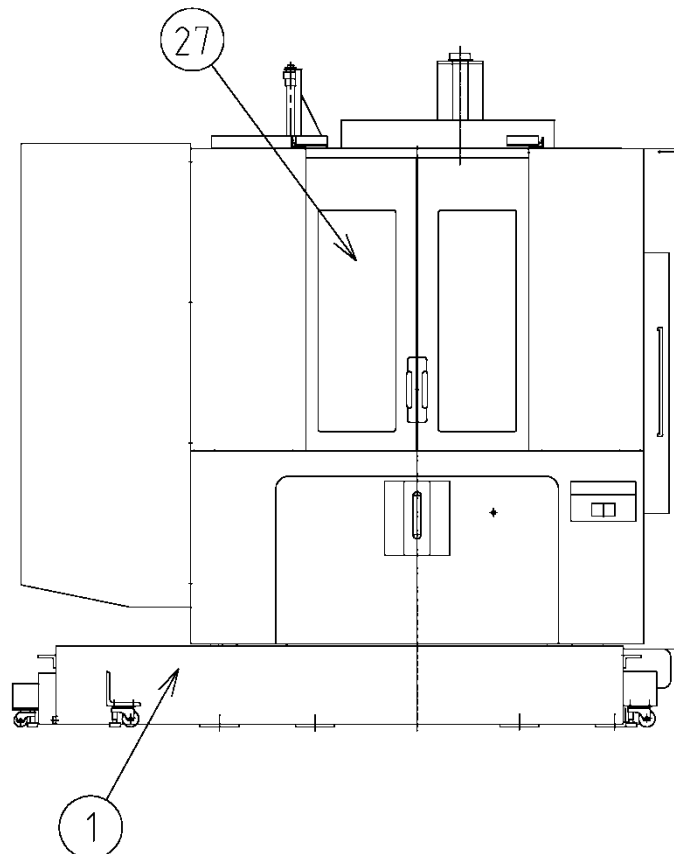
B. OUTLINE OF MACHINE

Front View

(40/60ATC)



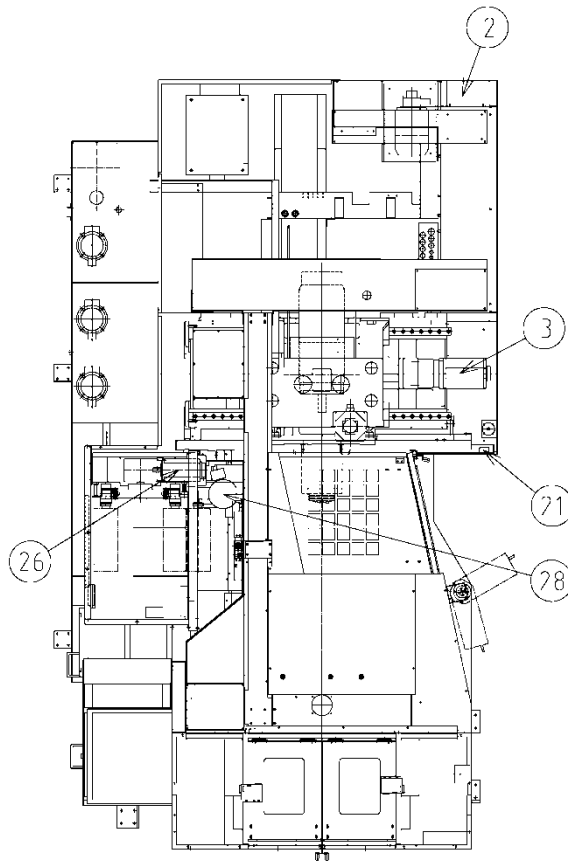
(80/120ATC)



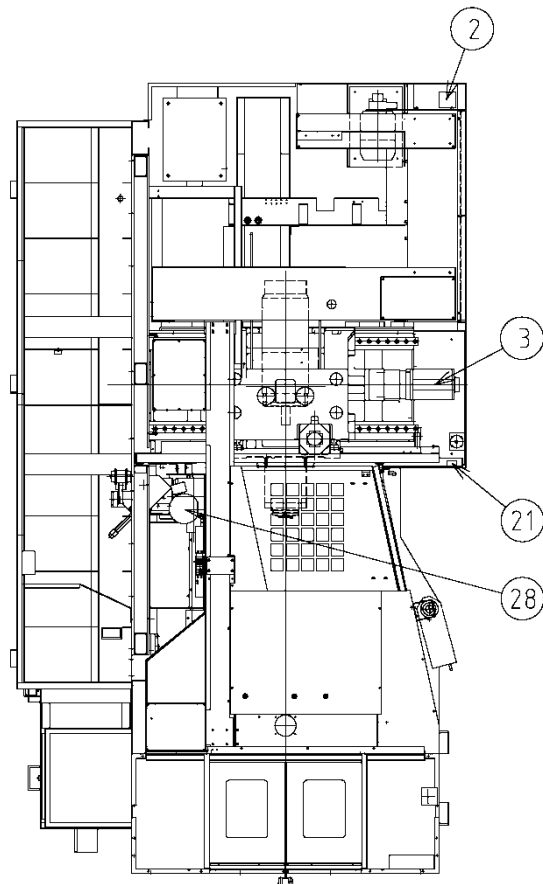
B. OUTLINE OF MACHINE

Top View

(40/60ATC)

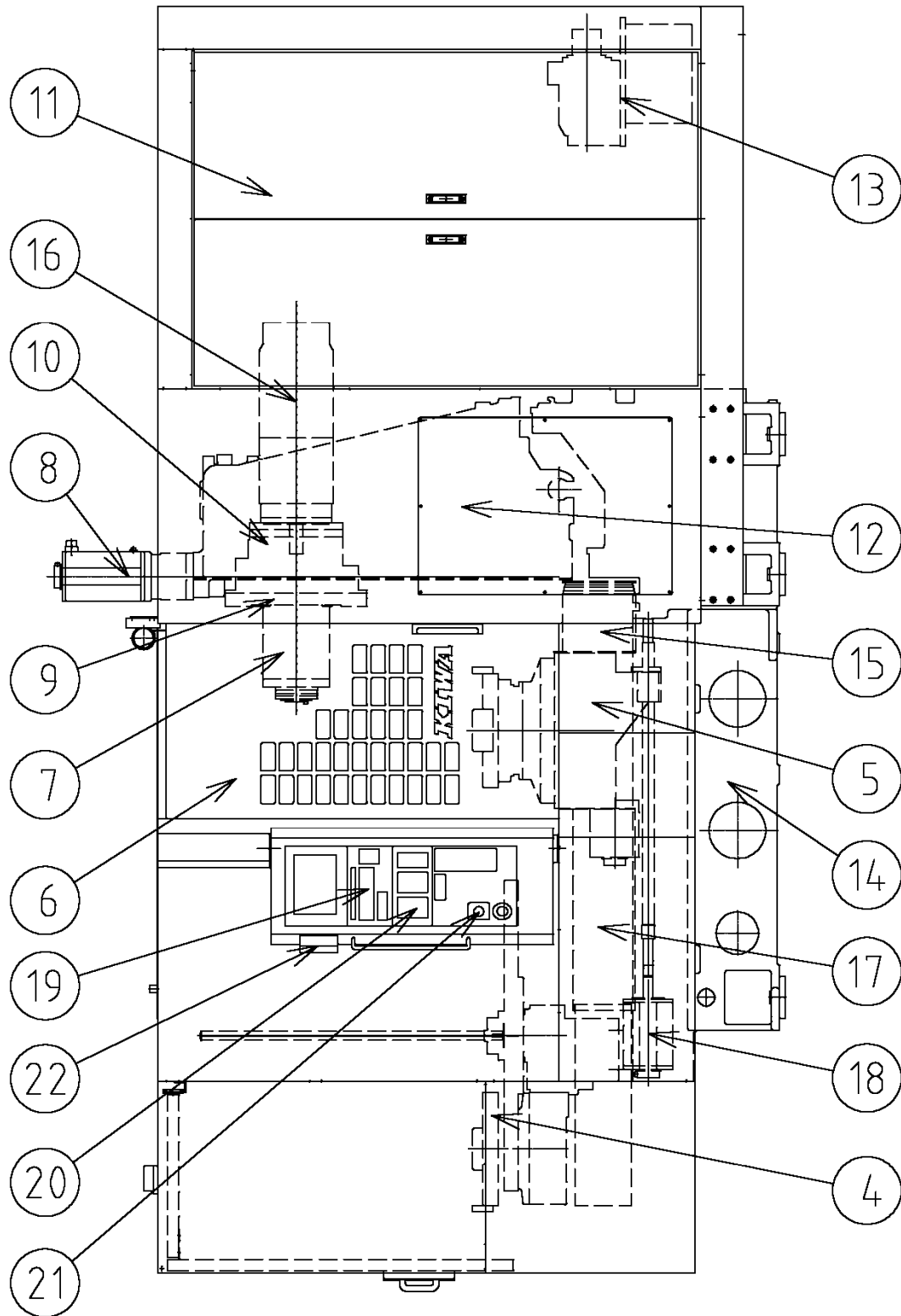


(80/120ATC)



B. OUTLINE OF MACHINE

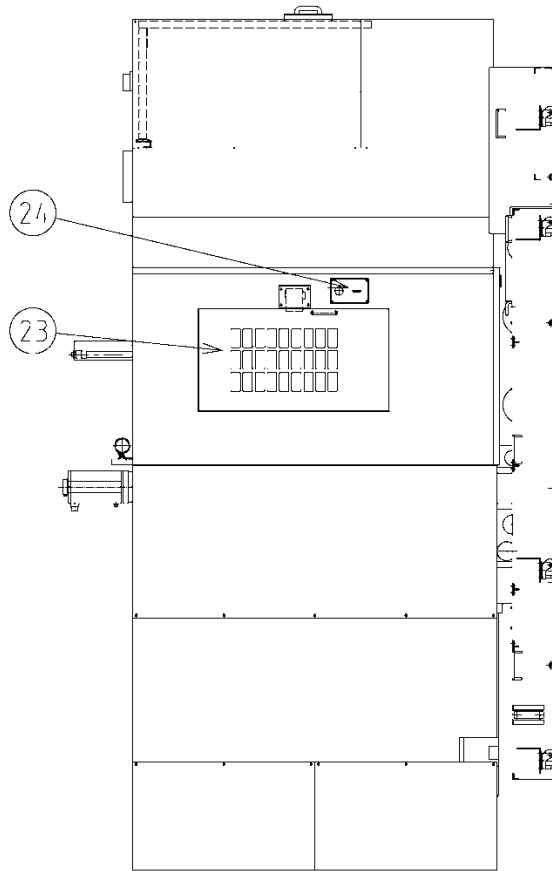
Right Side View



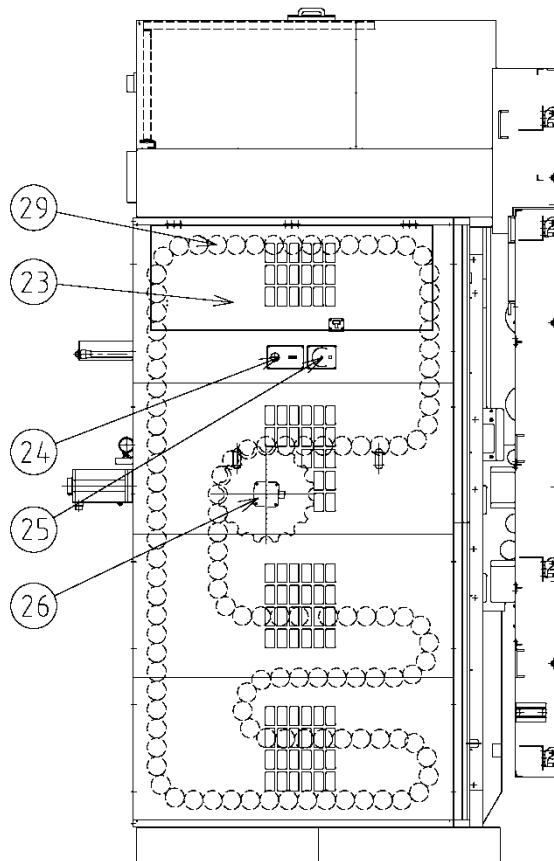
B. OUTLINE OF MACHINE

Left Side View

(40/60ATC)



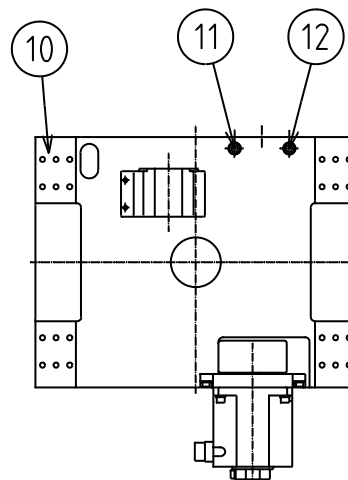
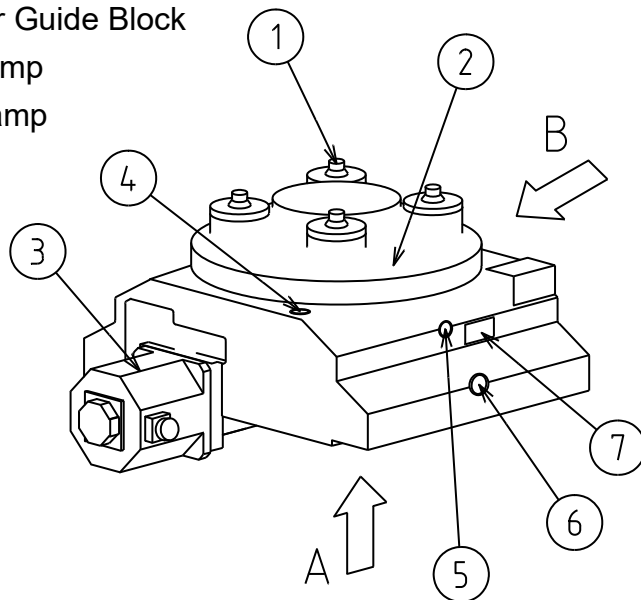
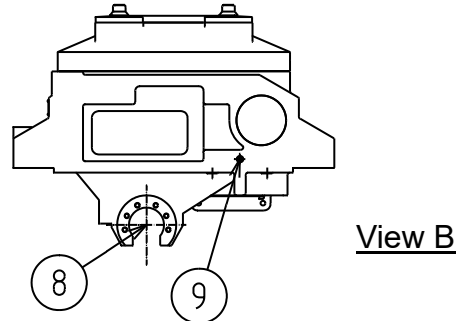
(80/120ATC)



B. OUTLINE OF MACHINE

B-2 Description of Rotary Table

- (1) Pallet Clamp Unit
- (2) Turn Table
- (3) Servo Motor
- (4) Port for Lubrication Oil
- (5) Oil Level Gauge
- (6) Drain for Lubrication Oil
- (7) Model Plate
- (8) Bracket for Ballscrew Nut
- (9) Air Inlet (RC 1/4)
- (10) Mounting Surface for Linear Guide Block
- (11) Hydraulic Port for Table Clamp
- (12) Hydraulic Port for Pallet Clamp

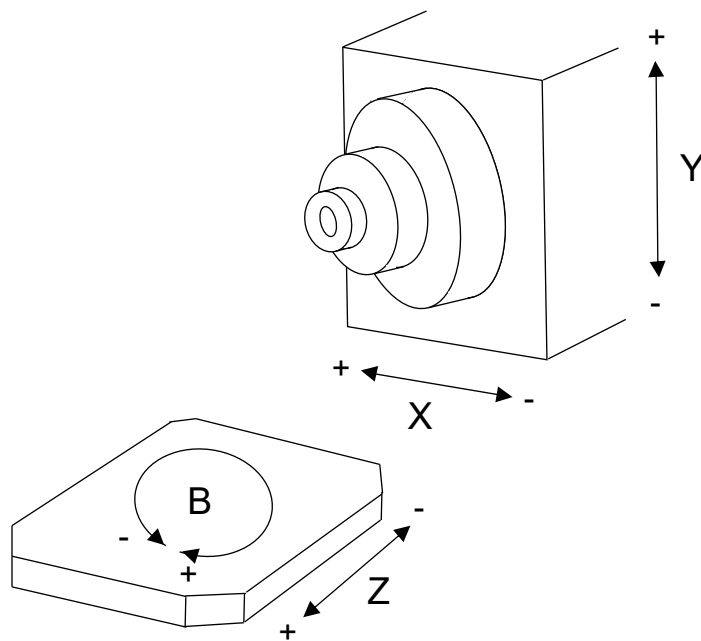


B. OUTLINE OF MACHINE

B-3 Features

Feed mechanism

X-axis	80 m/min	Column Traverse
Y-axis	80 m/min.	Spindle Head
Z-axis	80 m/min.	Table Traverse
B-axis	66.6 min. ⁻¹	Table Turn



Rigid tap

By synchronizing the Z-axis feed with spindle revolution, high-speed tapping is executed without floating tap holder.

Automatic tool changer (ATC)

Tools are correctly changed at high speed by taking the shorter route in magazine rotation.

Tool storage capacity in the magazine:

Standard	40 pcs
Option	60 pcs
	80 pcs
	120 pcs

B. OUTLINE OF MACHINE

B-4 Construction

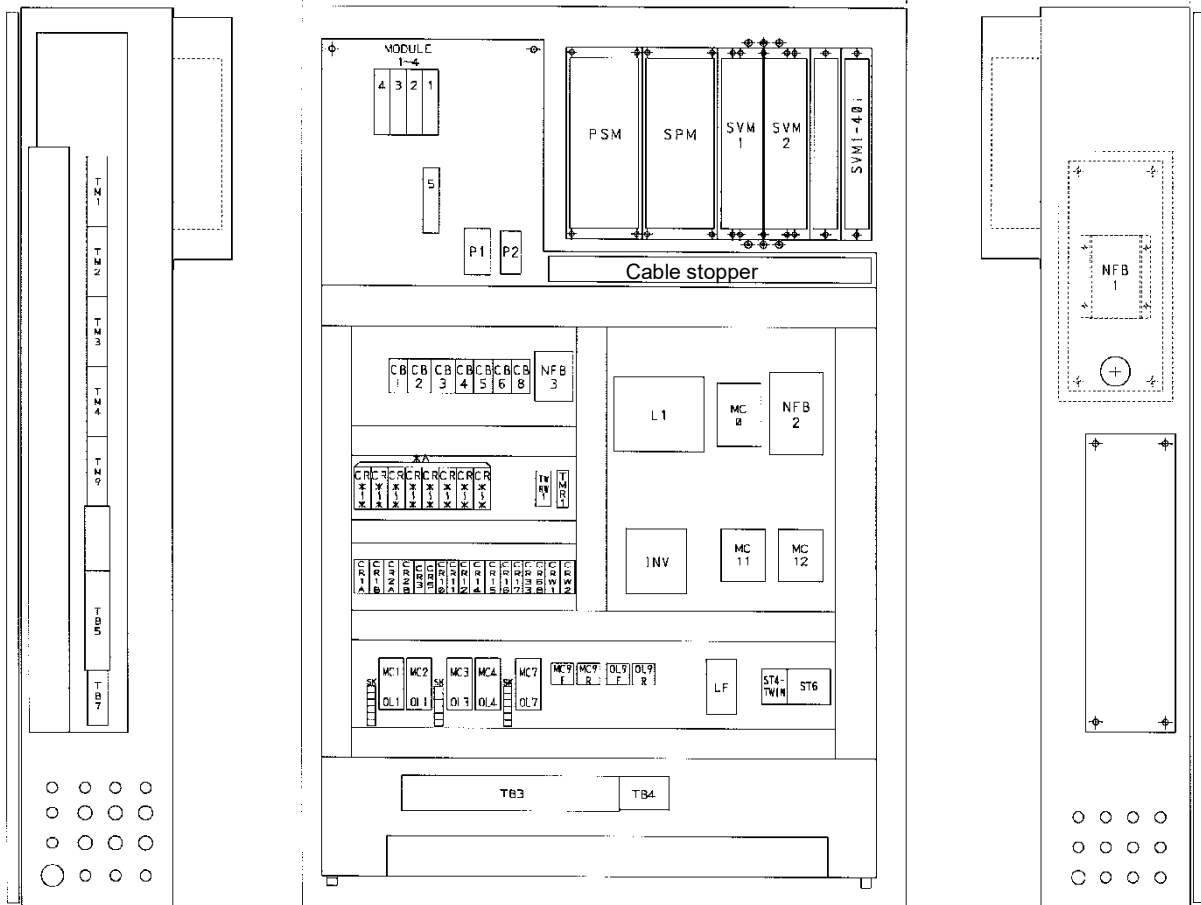
The machine of the standard specification includes the followings at delivery.

- * Machine body
- * ATC Magazine covers
- * ATC Shutter cylinder cover
- * Leveling plate 6 pc
- * Document box
 - a. Spare paint 1 set
 - b. Silicone Bond 1 tube
 - c. FANUC fuse 1 set
 - d. Machine Operation (Printed)/Maintenance manuals 1 set
including Inspection record and Address table (on CD)
 - e. FANUC manuals on CD 1 set
(Operation, Maintenance and Parameter)
 - f. Parts list, Electric diagrams, Parameter list on CD 1 set

C. SWITCHES AND PUSHBUTTONS

C. SWITCHES AND PUSHBUTTONS

C-1 Electric Box



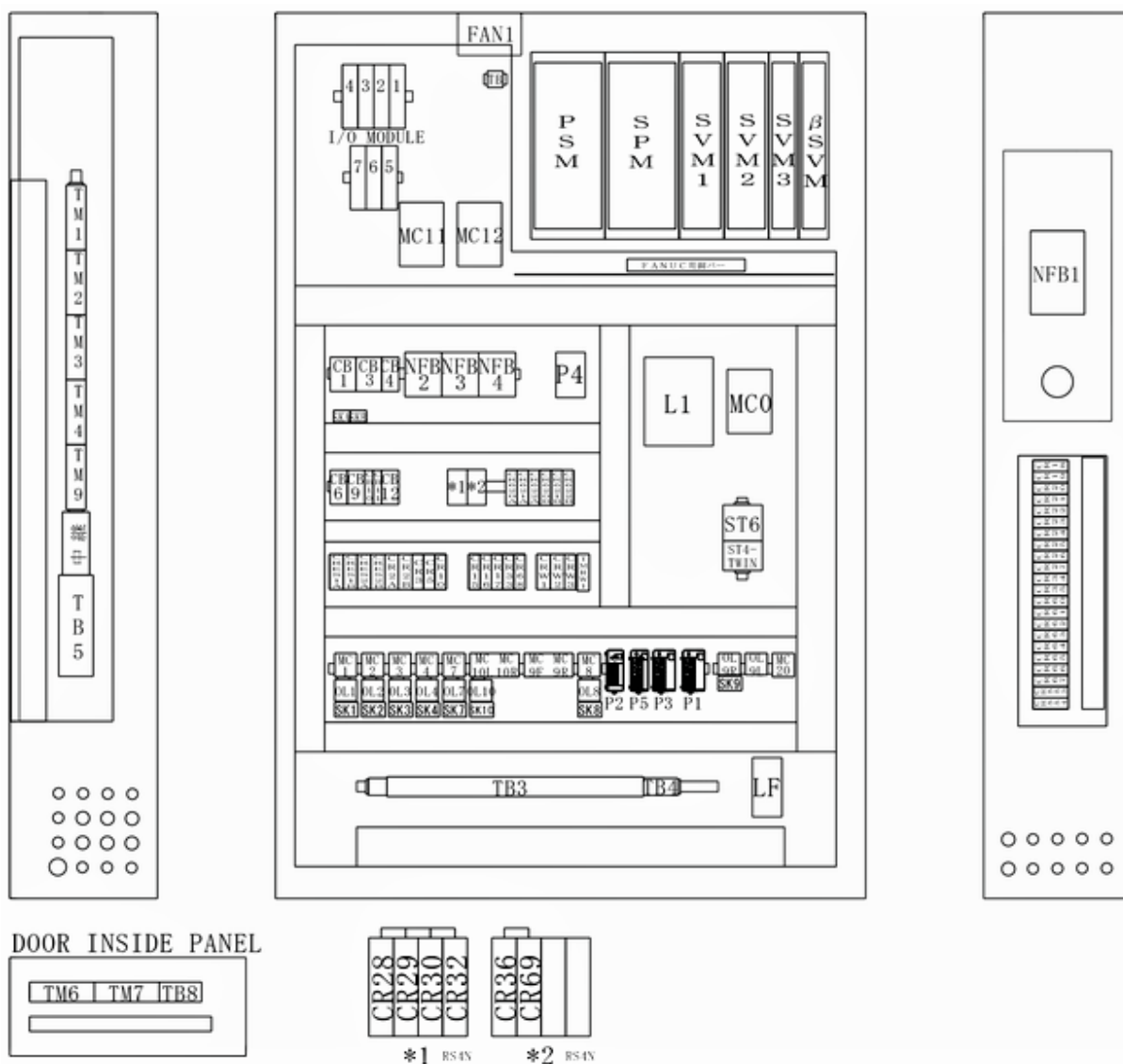
*A



CODE	DESCRIPTION	CODE	DESCRIPTION
CB	Circuit Protector	P	Switching Power Supply
CR	Relay	PSM	Power Supply Module
INV	Inverter Unit	SK	Surge Killer
L	AC Reactor	SPM	Spindle Amplifier Module
LF	AC Line Filter	SVM	Servo Amplifier Module
MC	Magnetic Contactor	SVM1-40i	Beta Amplifier Unit
MODULE	I/O Module	TB	Terminal Block
NFB	No-fuse Breaker	TM	Terminal Module
OL	Thermal Relay	TMR	Timer

C. SWITCHES AND PUSHBUTTONS

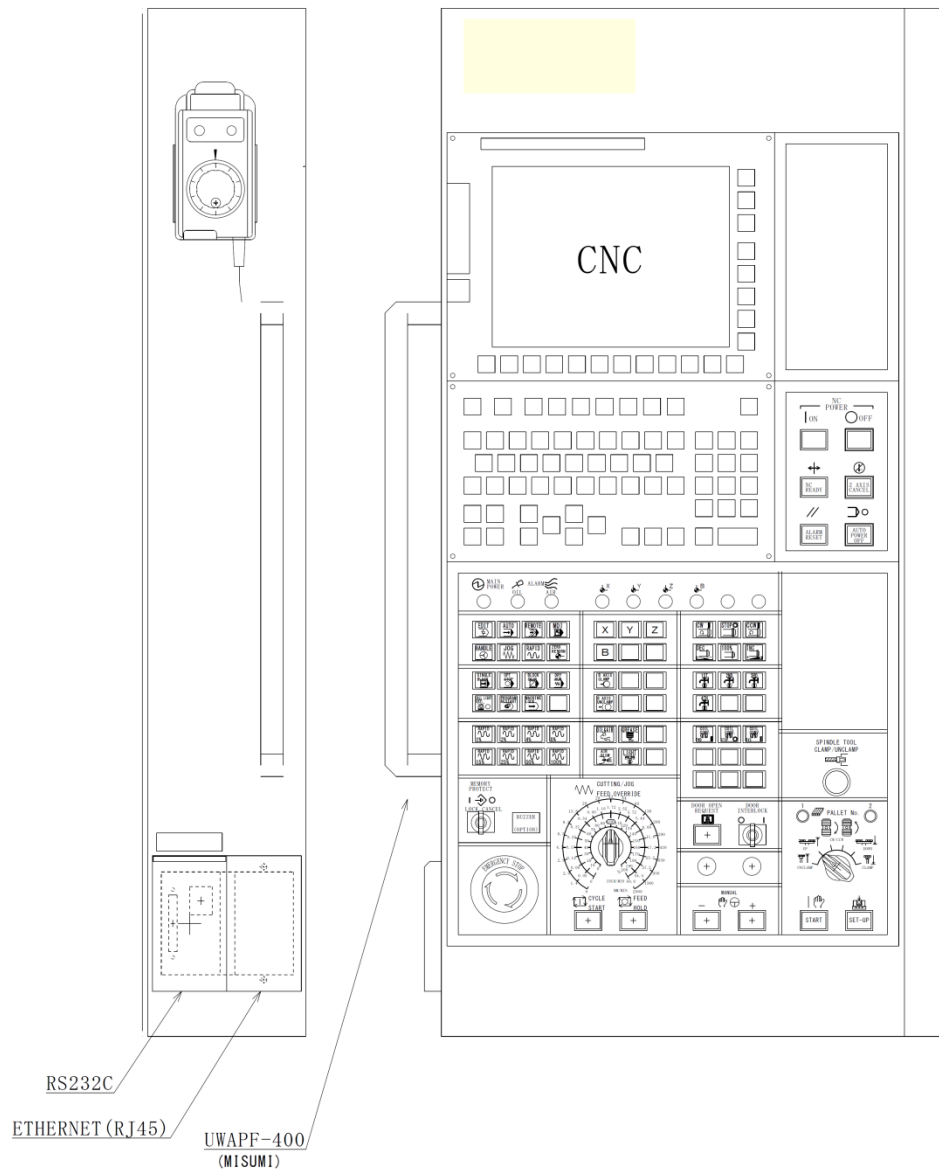
Electric Box (CE)



CODE	DESCRIPTION	CODE	DESCRIPTION
CB	Circuit Protector	P	Switching Power Supply
CR	Relay	PSM	Power Supply Module
INV	Inverter Unit	SK	Serge Killer
L	AC Reactor	SPM	Spindle Amplifier Module
LF	AC Line Filter	SVM	Servo Amplifier Module
MC	Magnetic Contactor	SVM1-40i	Beta Amplifier Unit
MODULE	I/O Module	TB	Terminal Block
NFB	No-fuse Breaker	TM	Terminal Module
OL	Thermal Relay	TMR	Timer

C. SWITCHES AND PUSHBUTTONS

Main Operation Box



C. SWITCHES AND PUSHBUTTONS

Signal Light [option]

Single-Color (Yellow) Type

Mode of Light	Condition	How to Turn Off
Continuously lit	- Program end [M02, M30] - Program stop [M00, M01]	Press Cycle Start pushbutton (70) to repeat the program, or to restart the suspended program.
	- Message 2017 * (Air Filter)	Check the condition of the air filter and replace it, if necessary. Then, press Signal Light (Call Light) off Pushbutton (13).
Blinks slowly	- Waiting for pallet set-up	When set-up is finished, the lamp will go off.
Blinks rapidly	- Alarm	Remove the cause of the alarm and reset the machine.

Three-Color Type

Mode of Light	Condition	How to Turn Off
Yellow Continuously lit	- Program end [M02, M30] - Program stop [M00, M01]	Press Cycle Start pushbutton (70) to repeat the program, or to restart the suspended program.
	- Message 2017 * (Air Filter)	Check the condition of the air filter and replace it, if necessary. Then, press Signal Light (Call Light) off Pushbutton (13).
Yellow Blinks slowly	- Waiting for pallet set-up	When set-up is finished, the lamp will go off.
Red Blinks rapidly	- Alarm	Remove the cause of the alarm and reset the machine.
Green Continuously lit	- Automatic Operation	

* Message 2017 appears at intervals of 14,400min operation.

C. SWITCHES AND PUSHBUTTONS

Power Lamp (Source Lamp)

This lamp is lit when power is supplied to the operation circuit, by turning on Main Power Switch.

Main Power Switch (NFB1)

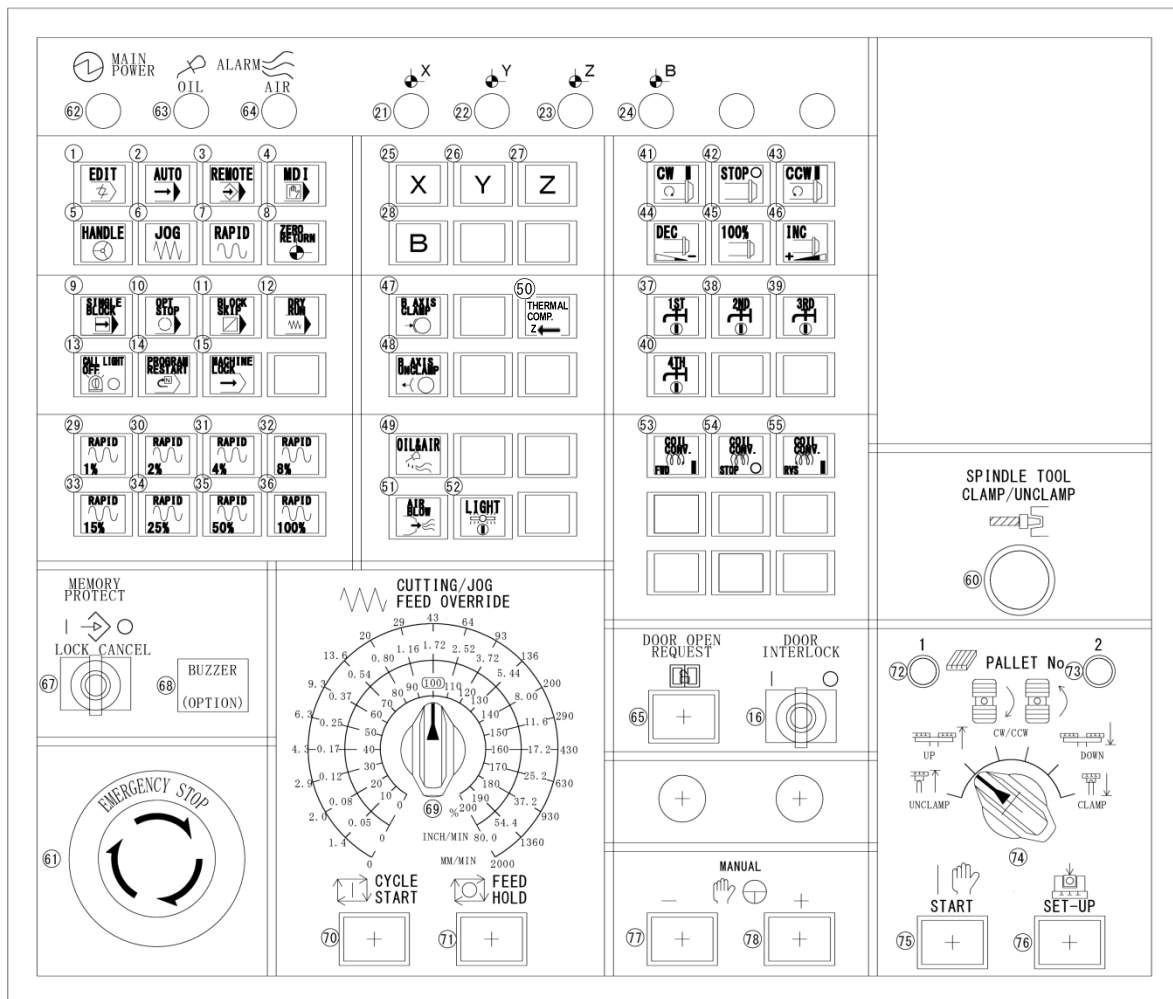
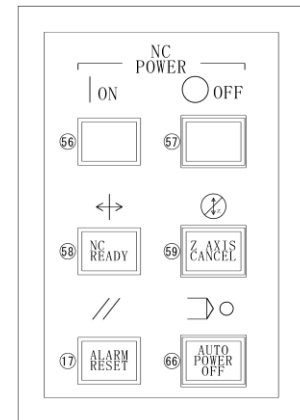
This is the Main Power Switch (Breaker) of the machine. When the factory power is turned on, it comes to the input side of this switch.

Weekly Timer (on Electric Box Door)

See Section D-7 “Weekly Timer” of this manual.

C. SWITCHES AND PUSHBUTTONS

C-2 Operation Panel of Machine

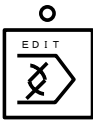
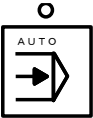




C. SWITCHES AND PUSHBUTTONS

1	EDIT Mode Pushbutton	40	4th Coolant Pushbutton
2	AUTO Mode Pushbutton	41	Spindle CW Rotation Pushbutton
3	REMOTE Mode Pushbutton	42	Spindle Stop Pushbutton
4	MDI Mode Pushbutton	43	Spindle CCW Rotation Pushbutton
5	HANDLE Mode Pushbutton	44	Spindle Speed Deceleration Pushbutton
6	JOG Mode Pushbutton	45	Spindle Speed 100% Pushbutton
7	RAPID Mode Pushbutton	46	Spindle Speed Acceleration Pushbutton
8	Zero Point Return Mode Pushbutton	47	B-axis Table Clamp Pushbutton
9	Single Block Pushbutton	48	B-axis Table Unclamp Pushbutton
10	Optional Stop Pushbutton	49	Oil & Air System Lubrication Oil Pushbutton
11	Block Skip Pushbutton	50	Thermal Displacement Compensation Lamp (Option)
12	Dry Run Pushbutton	51	Air Blow Pushbutton (Option)
13	Signal Light (Call Light) Off Pushbutton (Option)	52	Work Light ON/OFF Pushbutton (Option)
14	Program Restart Pushbutton (Option)	53	Coil Conveyor Forward Pushbutton (Option)
15	Machine Lock Pushbutton	54	Coil Conveyor Stop Pushbutton (Option)
16	Door Interlock Switch	55	Coil Conveyor Reverse Pushbutton (Option)
17	Alarm Reset Pushbutton	56	NC ON Pushbutton
18	(Option)	57	NC OFF Pushbutton
19	(Option)	58	NC Ready Pushbutton
20	(Option)	59	Z-axis Cancel Pushbutton
21	X-axis Zero Point Return Completion Lamp	60	Spindle Tool Clamp/Unclamp Pushbutton
22	Y-axis Zero Point Return Completion Lamp	61	Emergency Stop Pushbutton No. 1
23	Z-axis Zero Point Return Completion Lamp	62	Main Power Lamp
24	B-axis Zero Point Return Completion Lamp	63	Lubrication Oil Alarm Lamp
25	X-axis Selection Pushbutton	64	Air Pressure Alarm Lamp
26	Y-axis Selection Pushbutton	65	Door Open Request Pushbutton
27	Z-axis Selection Pushbutton	66	Auto Power OFF Pushbutton (Option)
28	B-axis Selection Pushbutton	67	Memory Protect Release Switch
29	Rapid Feed Override 1% Pushbutton	68	Buzzer (Option)
30	Rapid Feed Override 2% Pushbutton	69	Feed Rate Override and JOG Feed Setting Switch
31	Rapid Feed Override 4% Pushbutton	70	Cycle Start Pushbutton
32	Rapid Feed Override 8% Pushbutton	71	Feed Hold Pushbutton
33	Rapid Feed Override 15% Pushbutton	72	Pallet Position/APC Direction CCW Lamp
34	Rapid Feed Override 25% Pushbutton	73	Pallet Position/APC Direction CW Lamp
35	Rapid Feed Override 50% Pushbutton	74	Pallet Manual Selection Switch
36	Rapid Feed Override 100% Pushbutton	75	Pallet Start Pushbutton
37	1st Coolant Pushbutton	76	Pallet Set-up Pushbutton
38	2nd Coolant Pushbutton	77	Minus Direction Feed Pushbutton
39	3rd Coolant Pushbutton (Option)	78	Plus Direction Feed Pushbutton

Note: Pushbuttons (1) to (8) are Mode Selection Pushbuttons. Press a pushbutton, and the lamp lights on. Machine will be in the mode whose lamp is lit on. For checking lamps, M Code No. M199 is prepared. By M199, all lamps on the operation panel should be lit for 5 seconds.

C. SWITCHES AND PUSHBUTTONS

Appellation	Function
<p>(1) EDIT Mode Pushbutton</p> <div style="text-align: center; margin-top: 20px;">  </div>	<p>Press this button. The lamp lights up and Edit Mode is effective. Program can be registered into the memory. Modification, insertion, and deletion of the program can be made by using keys on the NC Key Board.</p>
<p>(2) AUTO Mode Pushbutton</p> <div style="text-align: center; margin-top: 20px;">  </div>	<p>Press this button. The lamp lights up and AUTO Mode is effective. The program stored in the memory can be executed. Program number search and sequence number search of the program in the memory are available.</p>
<p>(3) REMOTE Mode Pushbutton</p> <div style="text-align: center; margin-top: 20px;">  </div>	<p>Press this button. The lamp lights up and Remote Mode is effective. The programs read through RS232C interface can be executed.</p>
<p>(4) MDI Mode Pushbutton</p> <div style="text-align: center; margin-top: 20px;">  </div>	<p>Press this button. The lamp lights up and MDI mode is effective. Data input is available directly from keys on the NC Operator's panel. The entered program can be started by pressing Cycle Start pushbutton (70).</p>

C. SWITCHES AND PUSHBUTTONS

(5) HANDLE Mode Pushbutton



This mode is used to provide minute feed with Manual Pulse Generator (79). Select an axis with Axis Selection Switch on Manual Pulse Generator. Select amount scale with its Handle Feed Scale Selection Switch [x1 (=0.001 mm or 0.001°), x10 (=0.01 mm or 0.01°), x100 (=0.1 mm or 0.1°)].

While turning the handle of Manual Pulse Generator (79), the selected axis moves at selected minute feed rate.

(6) JOG Mode Pushbutton

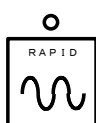


Press this button. The lamp lights up and JOG Feed is effective. This mode is used to provide continuous feed by manual operation. Select an axis with Axis Selection pushbutton (25), (26), (27) or (28). Press Minus Direction Feed pushbutton (77) or Plus Direction Feed pushbutton (78). While the button (77) or (78) is being pressed, the selected axis moves continuously.

The feed rate can be changed with Feed Rate Override and JOG Feed Setting Switch (69).

This mode is also used to manually operate ATC and APC.

(7) RAPID Mode Pushbutton



Press this button. The lamp lights up and RAPID Feed is effective. This mode is used to run axis at a rapid traverse. Select an axis with Axis Selection pushbutton (25), (26), (27) or (28). Press

C. SWITCHES AND PUSHBUTTONS

Minus Direction Feed pushbutton (77) or Plus Direction Feed pushbutton (78). While the button (77) or (78) is being pressed, the selected axis moves continuously at a rapid traverse. The feed rate can be changed with Rapid Feed Override pushbuttons (29) to (36).

(8) ZERO Point Return Mode Pushbutton

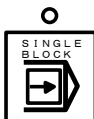


This mode is used to execute zero point return. Press this button (the lamp is lit), and select an axis with Axis Selection Pushbutton (25), (26), (27) or (28). Press Plus Direction Feed pushbutton (78) until the corresponding Zero Return Completion lamp (21), (22), (23) or (24) lights on. Rapid Feed Override pushbuttons (29) to (36) are effective in this mode. Refer to "E-1 Zero Point Return".

Note 1: An absolute type encoder is used for each axis of the machine, so there is usually no need to execute zero point return after turning on the machine.

Note 2: ZERO RETURN should be performed more than 100mm away from zero point.

(9) Single Block Pushbutton



When this button is pressed during automatic operation or MDI operation, the lamp lights up. The machine stops after executing one block of the program. With this pushbutton (9) turned on, each one press of Cycle Start pushbutton (70) executes each one block.

During G28, G29, or G30 the machine is stopped at

C. SWITCHES AND PUSHBUTTONS

an intermediate point and Feed Hold pushbutton (71) lights up.

In the canned cycle, the machine stops at the end of the rapid traverse to the point R and Feed Hold pushbutton (71) lights up. (Refer to FANUC's "Operator's Manual".)

While the machine is stopped by single block, manual and MDI operation is available.

To restart the suspended program, press Cycle Start pushbutton (70) in the original mode.

Note 1: If MDI operation is executed during automatic operation or vice versa, modal data affects the latter operation.

Note 2: If a single block is commanded during operation, the machine is stopped after executing the current block. Before restarting the operation, do not press [RESET] key; if [RESET] key is pressed, the next block information already read into the buffer storage will be cleared, and skipped.

(10) Optional Stop Pushbutton



When this button is pressed during automatic operation, the lamp lights up. Cycle operation is stopped after a block containing M01 is executed, and Program End Signal Light is lit. To restart cycle operation, press Cycle Start pushbutton (70). If this button (10) is turned off, cycle operation is not stopped even after a block containing M01 is executed.

(11) Block Skip Pushbutton

C. SWITCHES AND PUSHBUTTONS



When this button is pressed during automatic operation, the lamp lights up. And the block beginning with "/" is ignored.

When this button is turned off, the block beginning with "/" is executed.

Optional Block Skip is identified when "/" is read into the buffer from the tape or memory. If a block preceded by a slash has been read into the buffer before Block Skip pushbutton (11) is pressed, it can not be ignored.

(12) Dry Run Pushbutton



When this button is pressed, the lamp lights up and F code specified in the program is ignored. In this condition, cutting feed is not subject to F code but to JOG Feed speed set with Feed Rate Override and JOG Feed Setting switch (69).

In tapping cycle, this button is not effective. In rapid traverse this button is normally ineffective. However, it is possible to make this button also effective for rapid traverse by parameter setting.

Note: When stopping operation in Dry Run, make sure to press this pushbutton (12) again and put the light off after axis movement stops.

C. SWITCHES AND PUSHBUTTONS

(13) Signal Light (Call Light) Off Pushbutton (Option)



This button is used to turn off the Signal Light. When this button is pressed, the Signal Light is turned off.

This Signal Light is lit in the following cases:

1. The program is ended with M02 or M30.
2. The program is suspended with M00, or M01 when Optional Stop pushbutton (10) is pressed.
3. The message on the life gage of the main air filter appears on LCD.
4. An NC alarm occurs ("ALM" is on LCD).
5. A spindle alarm occurs.
6. One cycle of ATC operation exceeds a certain amount of time (15 seconds).

This button can turn off the Signal Light only in Cases 1 to 3 above. In Case 3, check the life gage of the main air filter and then press this button. The signal light will go off, and the message will disappear.

In the other cases, remove the cause of the alarm, and then press Reset button of NC Operation Key Board.

(14) Program Restart Pushbutton (Option)



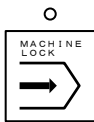
Pressing this button lights up the lamp and second pressing turns the lamp off. This function is available only when the lamp is on. When a block to restart is called by sequence No. search, M, S, T, and B Codes till then are displayed. (For details, please refer to FANUC Operator's Manual.)

This function is useful to restart program when a tool is broken or after a day off.

C. SWITCHES AND PUSHBUTTONS

Note: If the machine does not have this Fanuc option, the pushbutton (14) is used for M30 Restart.

(15) Machine Lock Pushbutton

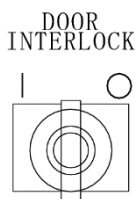


This pushbutton is used for test operation to check positional changes without actual machine movement.

Press this pushbutton for more than two seconds, and its lamp will be lit, then start a program; the movement of the axes is displayed on LCD as if the machine is actually moving. (Please refer to FANUC's Operator Manual.)

Note: To end the operation under Machine Lock, stop the program, press this pushbutton again to put its lamp off, and perform zero return on all the axes.

(16) Door Interlock Switch



This switch should be set at "ON" for normal operation.

It should be set at "OFF" only when necessary for set-up operation or maintenance work with the operation door opened.

Refer to Page g-8 of this manual.

C. SWITCHES AND PUSHBUTTONS

(17) Alarm Reset Pushbutton



This pushbutton resets a machine alarm condition (yellow or red signal light blinking) under PMC control. The status under CNC control is not reset by this pushbutton.

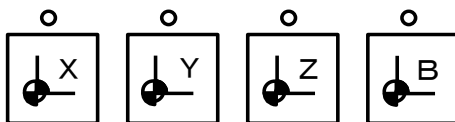
(18) - (20) (Option)

(21) X-axis Zero Return Completion Lamp

(22) Y-axis Zero Return Completion Lamp

(23) Z-axis Zero Return Completion Lamp

(24) B-axis Zero Return Completion Lamp



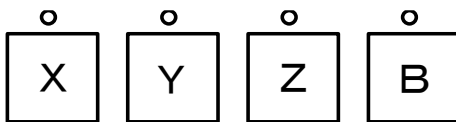
When the machine reaches respective zero points (reference points) in the execution of zero point return by manual or automatic operation (G28), corresponding lamps will light up. At the completion of 2nd zero point return, corresponding lamps will blink.

Note 1: An absolute type encoder is used for each axis of the machine, so there is usually no need to execute zero point return after turning on the machine.

Note 2: These lamps will not light up except for the case of zero point return execution, even if the machine comes to its zero point.

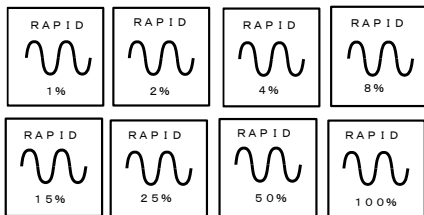
C. SWITCHES AND PUSHBUTTONS

- (25) X-axis Selection Pushbutton
- (26) Y-axis Selection Pushbutton
- (27) Z-axis Selection Pushbutton
- (28) B-axis Selection Pushbutton



In manual mode except HANDLE, axis to traverse is selected by these buttons. The selected axis is lit on. In HANDLE mode, these pushbuttons are ineffective and only indicate the axis selected with Manual Pulse Generator (79).

- (29) Rapid Feed Override 1% Pushbutton
- (30) Rapid Feed Override 2% Pushbutton
- (31) Rapid Feed Override 4% Pushbutton
- (32) Rapid Feed Override 8% Pushbutton
- (33) Rapid Feed Override 15% Pushbutton
- (34) Rapid Feed Override 25% Pushbutton
- (35) Rapid Feed Override 50% Pushbutton
- (36) Rapid Feed Override 100% Pushbutton

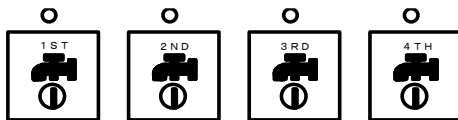


By pressing these pushbuttons in any mode, override of 1, 2, 4, 8, 15, 25, 50 and 100 % can be selected for Rapid Speed on all 4 axes.

Note: Feed Rate Override and JOG Feed Setting Switch (69) is not available for Rapid feed override.

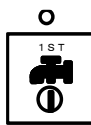
C. SWITCHES AND PUSHBUTTONS

- (37) 1st Coolant Pushbutton
- (38) 2nd Coolant Pushbutton
- (39) 3rd Coolant Pushbutton (option)
- (40) 4th Coolant Pushbutton



Maximum of 4 coolants can be used as according to individual requirements.

When either of these pushbuttons is pressed once, the respective coolant is discharged, and its lamp will light up. The next press of it turns off both its coolant pump and lamp. These coolant ON/OFF pushbuttons are effective regardless of mode selection. Therefore, it is possible to turn off the flow of coolant during machining at any mode. During AUTO, MDI, or REMOTE mode, coolant can also be discharged by using M-codes.

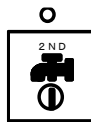


Coolant for machining tool

Corresponding M codes:

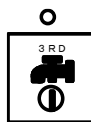
M08 1st coolant starts

M09 1st coolant and Oil mist/Air blow stop



Coolant for Pallet changing arms

No corresponding M code



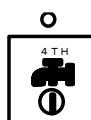
Coolant for Spindle Through Coolant System (Option)

Corresponding M codes:

M11 3rd coolant starts

M12 3rd coolant stops

Note: 3rd coolant is terminated by M6 and M106.



Coolant for Bed

Corresponding M codes:

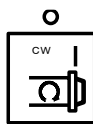
M15 4th coolant starts

C. SWITCHES AND PUSHBUTTONS

M16 4th coolant stops

Note: 2nd coolant and 4th coolant are automatically started when Cycle Start pushbutton (70) is pressed, except in Single block mode or MDI mode.

(41) Spindle CW Rotation Pushbutton

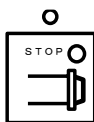


This button is effective in JOG Mode. (JOG Mode pushbutton (6) lights on.) When this button is pressed, the spindle rotates clockwise (forward). The lamp lights up in any mode when the spindle rotates forward.



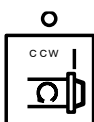
Do not rotate the spindle without a tool in it. Rotating the empty spindle at a high speed may damage inner parts of the spindle.

(42) Spindle Stop Pushbutton



This button is effective in HANDLE, JOG, RAPID or ZERO RETURN mode. When it is pressed, the spindle stops.

(43) Spindle CCW Rotation Pushbutton



This button is effective in JOG mode. (JOG Mode pushbutton (6) lights on.) When it is pressed, the spindle rotates counterclockwise (reverse). The lamp lights up in any mode when the spindle rotates in reverse.

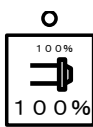
C. SWITCHES AND PUSHBUTTONS

(44) Spindle Speed Deceleration Pushbutton



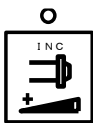
Pressing this button decelerates the spindle speed by every 10% until 50% in any mode.

(45) Spindle Speed 100% Pushbutton



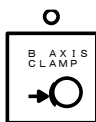
Spindle Speed set by Spindle Speed Deceleration pushbutton (44) or Spindle Speed Acceleration pushbutton (46) is returned to 100% by pressing this button. When spindle Speed is set to 100%, this lamp lights on.

(46) Spindle Speed Acceleration Pushbutton



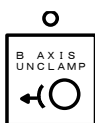
Pressing this button accelerates the spindle speed by every 10% until 150% in any mode.

(47) B-axis Table Clamp Pushbutton



Only in JOG mode, this button is effective. Pressing this button clamps B-axis Table. The lamp is lit on as far as B-axis Table is clamped. When clamped, the B-axis Table can't be rotated.

(48) B-axis Table Unclamp Pushbutton



Only in JOG mode, this button is effective. Pressing this button unclamps B-axis Table. The lamp is lit on as far as B-axis Table is unclamped. The B-axis should be rotated only when unclamped.

(49) Oil & Air System Lubrication Oil Pushbutton

C. SWITCHES AND PUSHBUTTONS



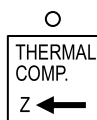
When this button is pressed, lubrication oil is supplied to the ballscrews, linear guides, and spindle for 30 seconds.

Oil & Air System

When NC is ready for operation, lubrication oil and air are automatically supplied to above parts.

Air is supplied as long as the NC is ready. The lubrication oil is supplied for 30 seconds, and after an interval of 6 minutes, again supplied for 30 seconds. The lubrication oil can also be supplied any time when this pushbutton is pressed. However, this pushbutton is ineffective during 30 seconds of lubrication and 10 seconds after that.

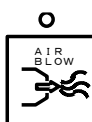
(50) Thermal Displacement Compensation Lamp (Option)



When Thermal Comp. selection switch in the electric cabinet is set for "ON", this lamp is lit, and Z-axis is controlled by Thermal displacement compensation unit.

Note :If Alarm of Sensor abnormal is generated, the compensation is not available.

(51) Air Blow Pushbutton (Option) (with lamp)



During operation of Air Blow, the lamp is lit on.

In Manual Mode

When this button is pressed Air Blow starts and the lamp lights up. Pressed again, Air Blow stops and the lamp goes off.

C. SWITCHES AND PUSHBUTTONS

In MDI Mode / AUTO Mode

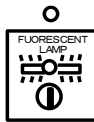
- During operation in MDI Mode or AUTO Mode with Air Blow, press this button to stop Air Blow. After the stop, when this button is pressed again, Air Blow starts.

M code (M09) command also stops Air Blow.

- During operation in MDI Mode or AUTO Mode without Air Blow, press this button to start Air Blow.

M code (M07) command also starts Air Blow.

(52) Work Light ON/OFF Pushbutton (Option)



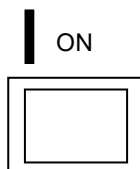
Pressing this button can switch on/off the work light. The work light is turned on every time the NC is powered on.

(53) Coil Conveyor Forward Pushbutton (Option)

(54) Coil Conveyor Stop Pushbutton (Option)

(55) Coil Conveyor Reverse Pushbutton (Option)

(56) NC ON Pushbutton (with lamp)

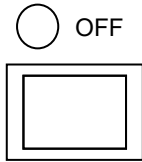


When this button is pressed, NC is powered on and "NOT READY" appears on the screen after a few seconds.

Note: Be sure to power on the machine first.

C. SWITCHES AND PUSHBUTTONS

(57) NC OFF Pushbutton

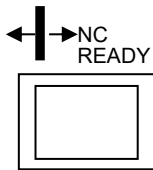


When this button is pressed, NC is powered off and LCD display disappears. Always press Emergency Stop pushbutton before pressing NC OFF pushbutton (57).



Be sure to press this button before turning off Main Switch of the electric box, or NC may be damaged.

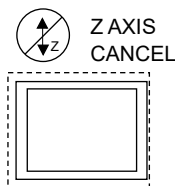
(58) NC Ready Pushbutton



With NC powered on or emergency stop released, press this button for a few seconds. NC enters its ready state and the lubrication pump starts.

The lamp (58) lights up when both the numerical control and mechanical system become ready for operation.

(59) Z-axis Cancel Pushbutton

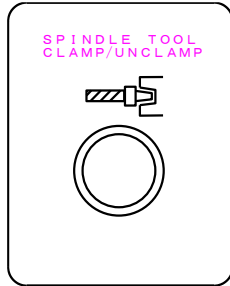


Z-axis does not move in any mode when this button is pressed. This button can be used for program check in AUTO mode. In this case, the axis positions are displayed only on LCD while actual movement is not made.

Note: Be careful. After using this pushbutton, the Z-axis position on LCD does not indicate its actual position.

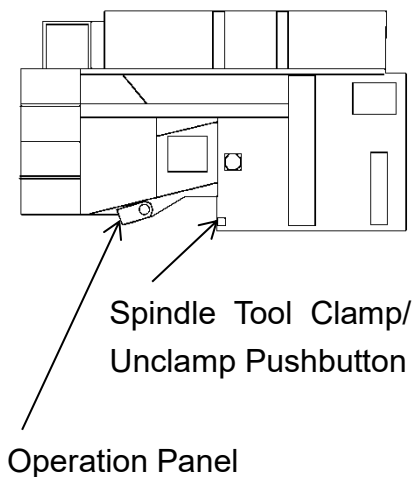
C. SWITCHES AND PUSHBUTTONS

(60) Spindle Tool Clamp/Unclamp Pushbutton



This switch is effective in JOG mode (JOG Mode Pushbutton is pressed and the lamp is lit on). Press this button once and the spindle tool will be unclamped. The spindle tool will remain unclamped till this button is pressed again. The lamp lights up when the spindle tool is in unclamped condition.

There is another Spindle Tool Clamp /Unclamp Pushbutton opposite the operation panel. This pushbutton can be used in the same way as that on the operation panel.



Note 1: Hold the tool by hand before unclamping it.

Note 2: Be sure to keep pressing the inside switch for one second or more, or it may not function.

Note 3: Spindle tool can not be unclamped while revolving.

Note 4: Even while unclamping, the spindle clamps the tool if the hydraulic pressure falls by emergency stop or power-off.

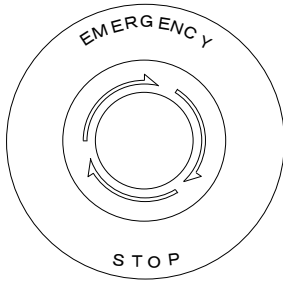
Note 5: If revolution or orientation of the spindle is commanded while spindle tool is unclamped, the machine goes into Feed Hold condition. Command spindle revolution or orientation with the spindle tool clamped.

C. SWITCHES AND PUSHBUTTONS

(61) Emergency Stop Pushbutton No.1 (with latch)



All personnel must know the location of EMERGENCY STOP buttons and how to use them in case of emergency.



This button is used to stop the machine at once in case of emergency. This is also used before cutting off all the power supply. Once this button is pressed, it remains latched in the stop position. To release the button, turn it clockwise.

When an emergency stop takes place, the power to the motors is interrupted, and all axial movements as well as spindle revolution are stopped.

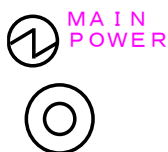
Note 1: Remove the cause of emergency stop before releasing it.

Note 2: After releasing this button, keep pressing NC Ready pushbutton (58) until “EMG” message disappears.

Note 3: All the commands for travel and spindle revolution read before emergency stop are cleared when operation is restarted.

Note 4: To release emergency stop status during ATC movement, refer to Chapter U of the Maintenance Manual.

(62) Main Power Lamp



This lamp is lit when Main Switch is turned on.

(It indicates the condition of 24V DC, whereas the power lamp in the rear indicates the condition of the main power (200V AC.).

C. SWITCHES AND PUSHBUTTONS

(63) Lubrication Oil Alarm Lamp



This lamp lights when the oil in the lubrication oil tank becomes short. Also this LED lights when the oil pressure falls lower than normal level. While this lamp is lit, the machine is in Feed Hold status.



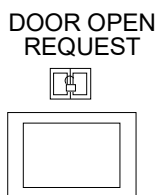
As the lubrication oil is supplied to the ball screws, linear guides, and spindle, the lubrication pump must function properly.

(64) Air Pressure Alarm Lamp



This lamp lights when the air supply is absent, or when the air pressure falls below about 0.3 MPa. While this lamp is lit, the machine is in Feed Hold status.

(65) Door Open Request Pushbutton

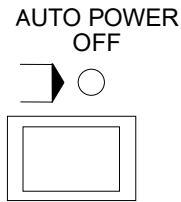


Before opening Operator Side Door, it's necessary to press this button. When pressed, the lamp is lit and the safety lock of the door is released.

To lock Operator Side Door again, shut the door completely, and the lamp of this switch will go off and the door will be locked automatically.

C. SWITCHES AND PUSHBUTTONS

(66) Auto Power OFF Pushbutton (option)



Pressing this button enables the Auto Power OFF function (its lamp lit on). When automatic operation ends (M30:), the machine goes into the emergency stop condition, then NC is powered off and finally the main switch is turned off, automatically. This button is depressed with one push, and comes out with another push.

Note 1: When the main power is turned on again, release this pushbutton.

Note 2: Do not use this Auto Power OFF function if the weekly timer is used.

(67) Memory Protect Release Switch (with key)



Be sure to set this switch to "LOCK" after edition or registration in memory.

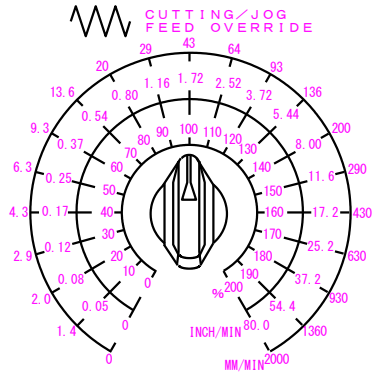


When this switch is set to "CANCEL", registration or edition of program is available. When this switch is set to "LOCK", the registration or edition is not available.

(68) Buzzer (Option)

C. SWITCHES AND PUSHBUTTONS

(69) Feed Rate Override and JOG Feed Setting Switch



Two different applications are possible with this switch according to the selected mode.

Feed Rate Override

The inner scale is used for this application. An override from 0 to 200% (every 10%) can be provided to every feed rate specified by the F function in automatic operation (AUTO, MDI). The feed rate cannot exceed 10,000 mm/min. in X/Y/Z axes, and 4800 degrees/min. in B-axis.

Normally, set this switch to 100%.

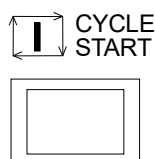
Jog Feed Setting

The outer scales are used for this application. In JOG mode, 21 feed rates from 0 to 2,000 mm/min. in X/Y/Z axes and 0 to 2000 degrees/min. in B-axis are available. This switch is also effective for the cutting feed in dry run.

Note 1: With this switch set at 0, no axis moves.
(Tap cycle is available.)

Note 2: Rapid Feed Override is not available with this switch (69). Please refer to Rapid Feed Override Pushbuttons (29) to (36).

(70) Cycle Start Pushbutton (with lamp)



Press this button, and AUTO/MDI operation will be started according to the selected mode. Cycle Start pushbutton (70) lamp lights up.

The Cycle Start lamp remains lit while the program is executed. It goes off either when the program is ended, when the feed hold is executed or when the

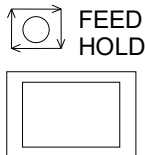
C. SWITCHES AND PUSHBUTTONS

operation is stopped [the Signal Light (option) will be lit when the program is ended or suspended].

In the following cases, Cycle Start pushbutton (70) is ignored:

1. Emergency stop remains effective.
2. Mode selection is not correct.
3. Sequence number search is going on.
4. An alarm still remains.
5. The numerical control system is not yet ready (when "NC READY" is not yet displayed on LCD).
6. The APC or ATC unit including the tool magazine has not yet reached its home position.

(71) Feed Hold Pushbutton (with lamp)



This button is used to stop automatic operation (AUTO and MDI).

When this button is pressed, the Cycle Start lamp (70) goes off and the Feed Hold lamp (71) lights up. All axial movements are decelerated and stopped. Also dwell is suspended.

For M and S functions, the machine stops after executing the current command.

In the tapping cycle (G84) or counter tapping cycle (G74), the machine stops when the cycle reaches its end, and all the while Feed Hold pushbutton (71) lamp is lit. If Feed Hold pushbutton (71) is pressed during the movement between the point R and the initial point, the movement stops immediately.

While feed hold is in effect, neither spindle revolution nor coolant flow stops, and manual operation is available.

If the machine is operated manually while

C. SWITCHES AND PUSHBUTTONS

automatic operation is suspended, axial positions may be shifted.

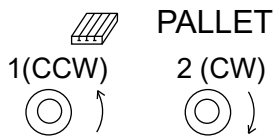
Therefore, go back to the initial positions before restarting automatic operation (Refer to FANUC's "Operator's Manual").

To restart the operation, press Cycle Start pushbutton (70).

Note: MDI command is not available while operation is suspended with feed hold.

(72) Pallet Position/APC Direction CCW Lamp

(73) Pallet Position/APC Direction CW Lamp

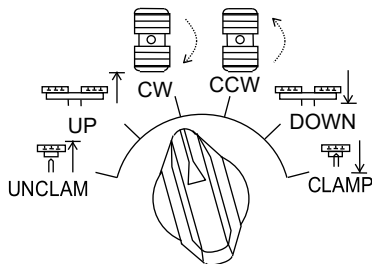


The lamps indicate which number of pallet is in the machining area.

During pallet change, one of them blinks to indicate the rotational direction of the pallet changing arms.

Note: Even if the rotation is interrupted by Emergency stop pushbutton, the lamp keeps blinking to show the direction of the last rotation.

(74) Pallet Manual Selection Switch

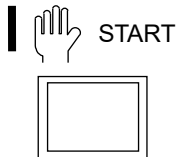


Only in JOG mode, this switch is effective. When Pallet Start pushbutton (75) is pressed, the movement selected by this switch is performed.

Note: This switch is effective only when the machine is in the APC ready position. Refer to Section I-3 of this manual.

C. SWITCHES AND PUSHBUTTONS

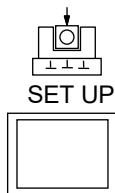
(75) Pallet Start Pushbutton



Pressing this button in JOG mode will perform the movement selected by Pallet Manual Selection Switch (74). When its lamp is lit on, manual operation of APC is possible.

As to CW/CCW rotation of the pallet changing arms, it moves only while this Start button is pressed.

(76) Pallet Set-up Pushbutton



When workpieces are set on the pallet of the setting side, press this button. The lamp is lit (the lamp of Pallet Set-up pushbutton in front is also lit), and the pallet is in a “set-up” status until a pallet change is started.

When this lamp is off in AUTO mode, pallets are not exchanged at an APC command, and the machine will wait until this button is pressed.

To cancel the set-up status of the pallet, press this button again. (The lamp goes off.)

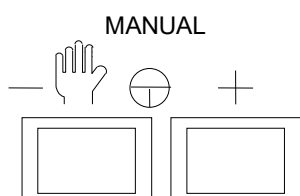
When the lamp of Pallet Set-up pushbutton (76) is lit, the front set-up doors are locked.

While pallets are changing places, the lamp of Pallet Set-Up pushbutton flickers until the pallet change is completed (and the locks on the set-up doors are released).

Note: Do not try to open the set-up doors while the lamp is flickering.

(77) Minus Direction Feed Pushbutton

(78) Plus Direction Feed Pushbutton



These buttons are effective in JOG, RAPID or

C. SWITCHES AND PUSHBUTTONS

ZERO RETURN mode.

The axis selected with Axis Selection pushbutton (25) to (28) moves in the Minus or Plus Direction according to the button pressed.

To execute zero point return, only the Plus Direction Feed pushbutton (78) should be pressed until the Zero Point Return Completion lamps (21) to (24) light up.

Note : + direction

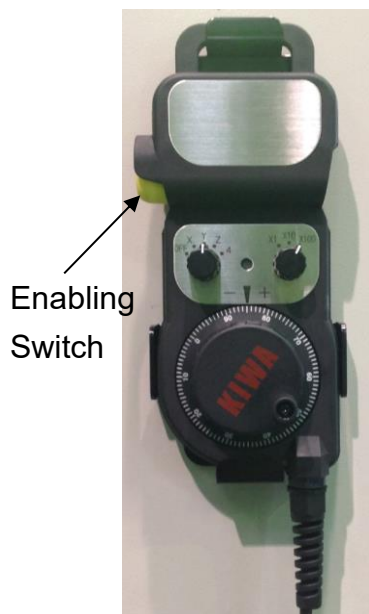
X-axis : toward left (Column movement)

**Y-axis : toward upward
(Spindle head movement)**

Z-axis : toward front side (Table movement)

B-axis : clockwise direction (Table turn)

(79) Manual Pulse Generator



Manual Pulse Generator (79) has an enabling switch. It is a three-position switch, and the manual pulse generator works only when the enabling switch is lightly pressed (middle position) while the operator door is open. When completely released or pressed to the end, it does not work. Feed of 0.001 mm or 0.001° (x1), 0.01 mm or 0.01° (x10), 0.1 mm or 0.1° (x100) per scale is available. Select axis and scale, then turn the Handle.

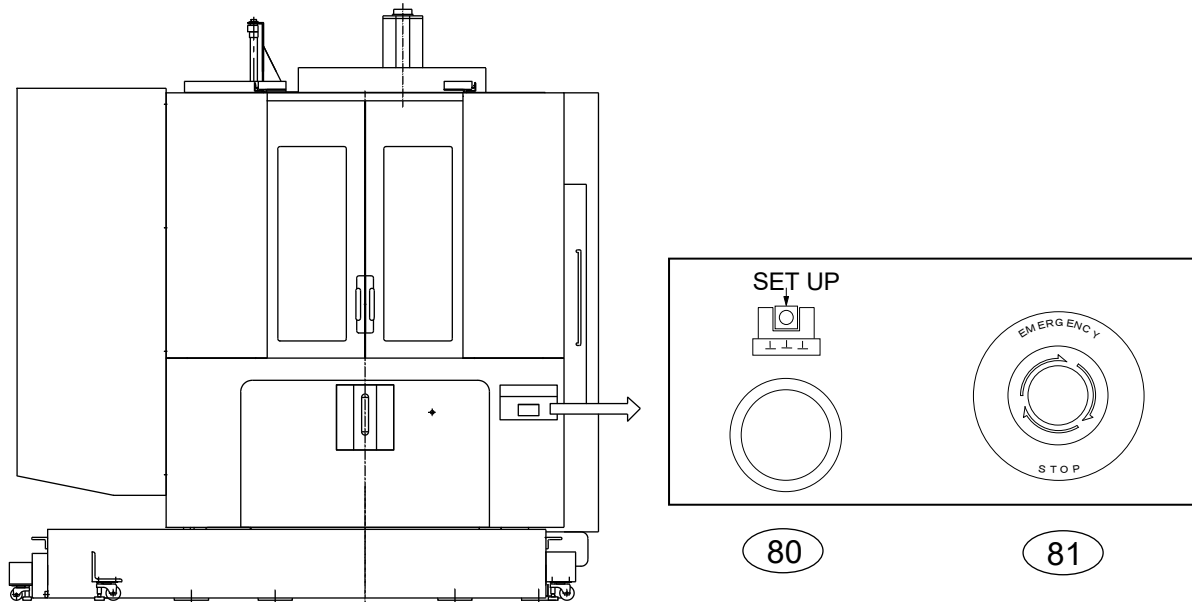
One rotation of the handle equals 100 scales. The handle should be rotated slower than 5 rotations a second.

See Section E-4.

C. SWITCHES AND PUSHBUTTONS

C-3 Other Operation Switches

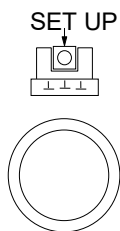
C-3-1 Pallet Setting Side



Appellation

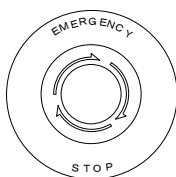
Function

(80) Pallet Set-up Pushbutton (with lamp)



Same function as Pallet Set-up pushbutton (76) on the machine operation panel. Refer to Section C-2 (76).

(81) Emergency Stop Pushbutton No.3 (with latch)

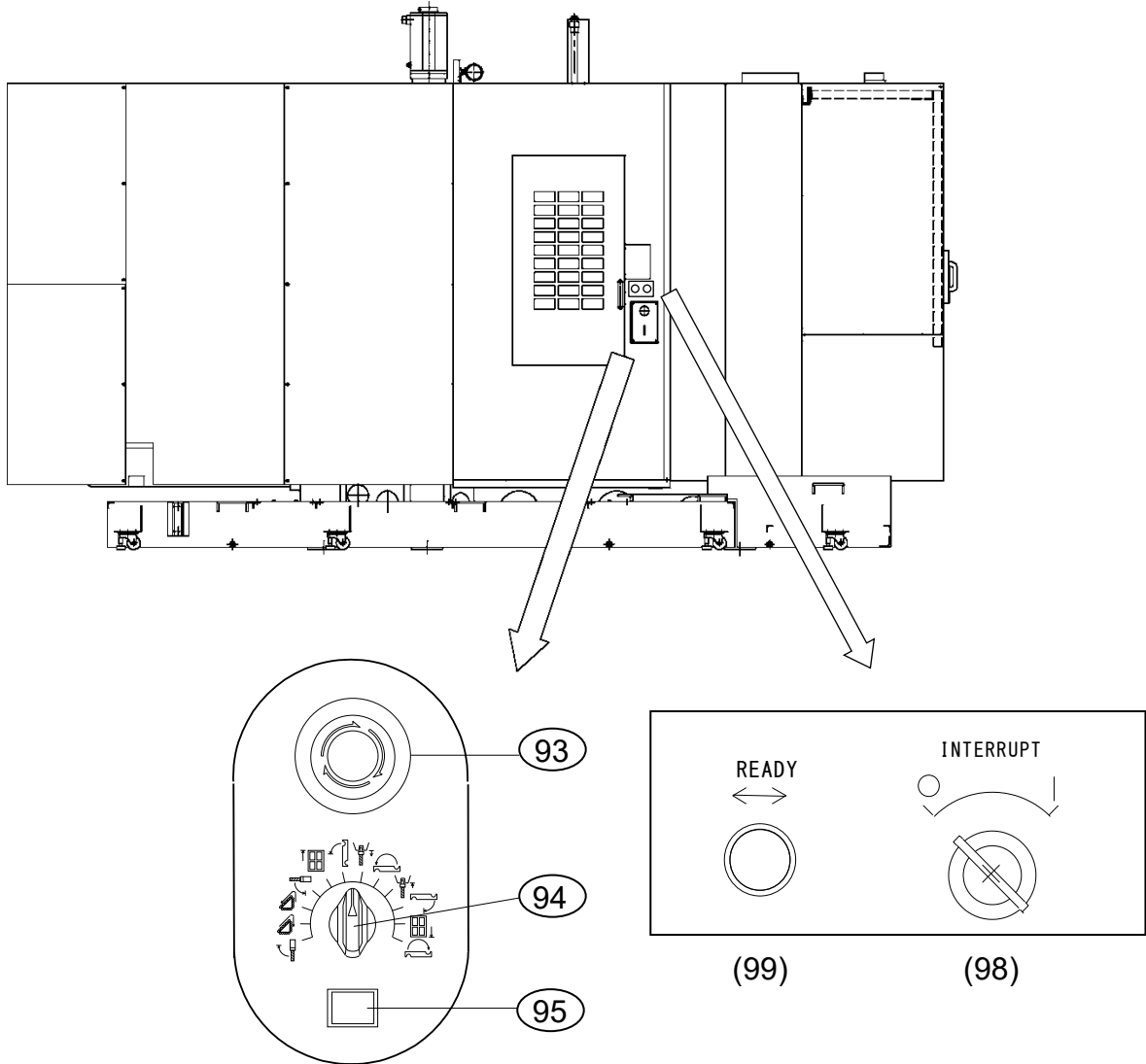


Same function as Emergency Stop pushbutton No.1 (61) on the machine operation panel. Refer to Section C-2 (61).

C. SWITCHES AND PUSHBUTTONS

C-3-2 ATC Magazine Side

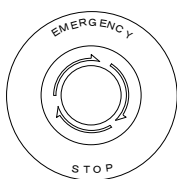
(40/60ATC)



Appellation

Function

(93) Emergency Stop Pushbutton No.2 (with latch)

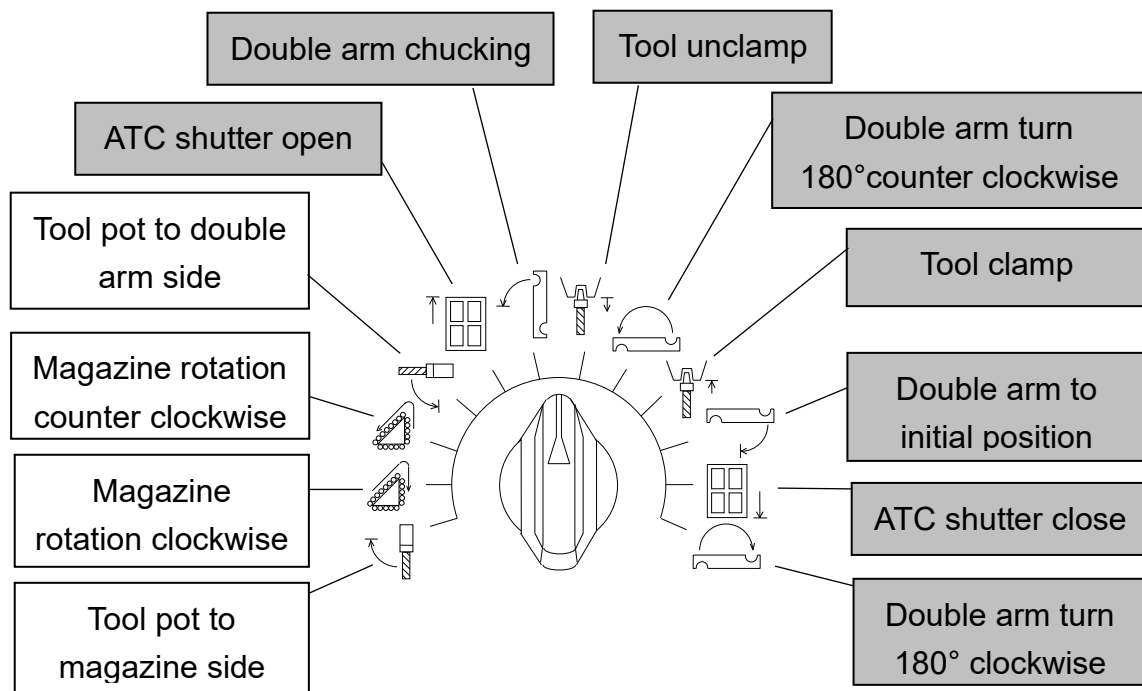
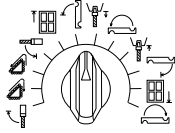


Same function as Emergency Stop pushbutton No.1 (61) on the machine operation panel. Please refer to Section C-2 (61).

C. SWITCHES AND PUSHBUTTONS

(94) ATC Manual Operation Switch

Each movement in ATC can be selected with this switch, and then executed by ATC Manual Start pushbutton (95) in JOG Mode.



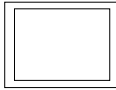
Note : There are limitations on the actions by ATC Manual Operation Select switch.

- Movements in are available only in JOG MODE and when spindle is in Tool change position.
- Movements in are available even during automatic operation if ATC magazine is stopped.
- Please refer to Chapter U of the Maintenance Manual.

C. SWITCHES AND PUSHBUTTONS

(95) ATC Manual Start Pushbutton

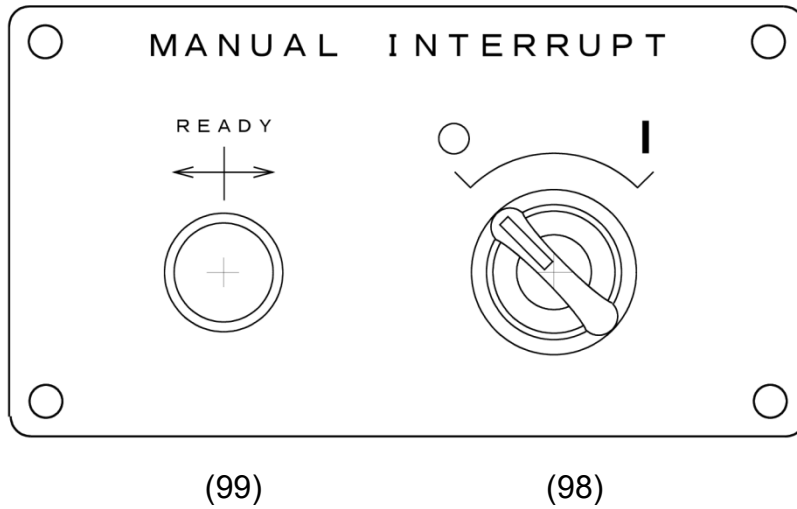
START



The ATC movement selected with the ATC Manual Operation Switch (94) is preformed by pressing this button.

Note: Be sure to close the ATC Magazine Door when rotating the tool magazine.

C. SWITCHES AND PUSHBUTTONS



(98) Manual Interrupt Selection Switch



When NC is ready, setting this switch at “T” will release the electromagnetic lock of the tool replacement door. You can open it.

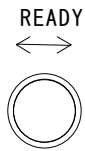
In automatic operation, if a T-code command is being executed or if tools are being exchanged, the Manual interrupt lamp (99) will blink and the electromagnetic lock will hold. When above actions are finished, the lamp will be lit continuously and the lock will be released.

After finishing tool replacement using Magazine rotation pushbutton, set Manual Interrupt Selection Switch (98) at “O”. Manual interrupt operation will be finished and the interrupted operation will be resumed if any. The lamp (99) will go off.

Note: Please avoid rapidly repeating on/off operation of Manual Interrupt Selection Switch (98).

C. SWITCHES AND PUSHBUTTONS

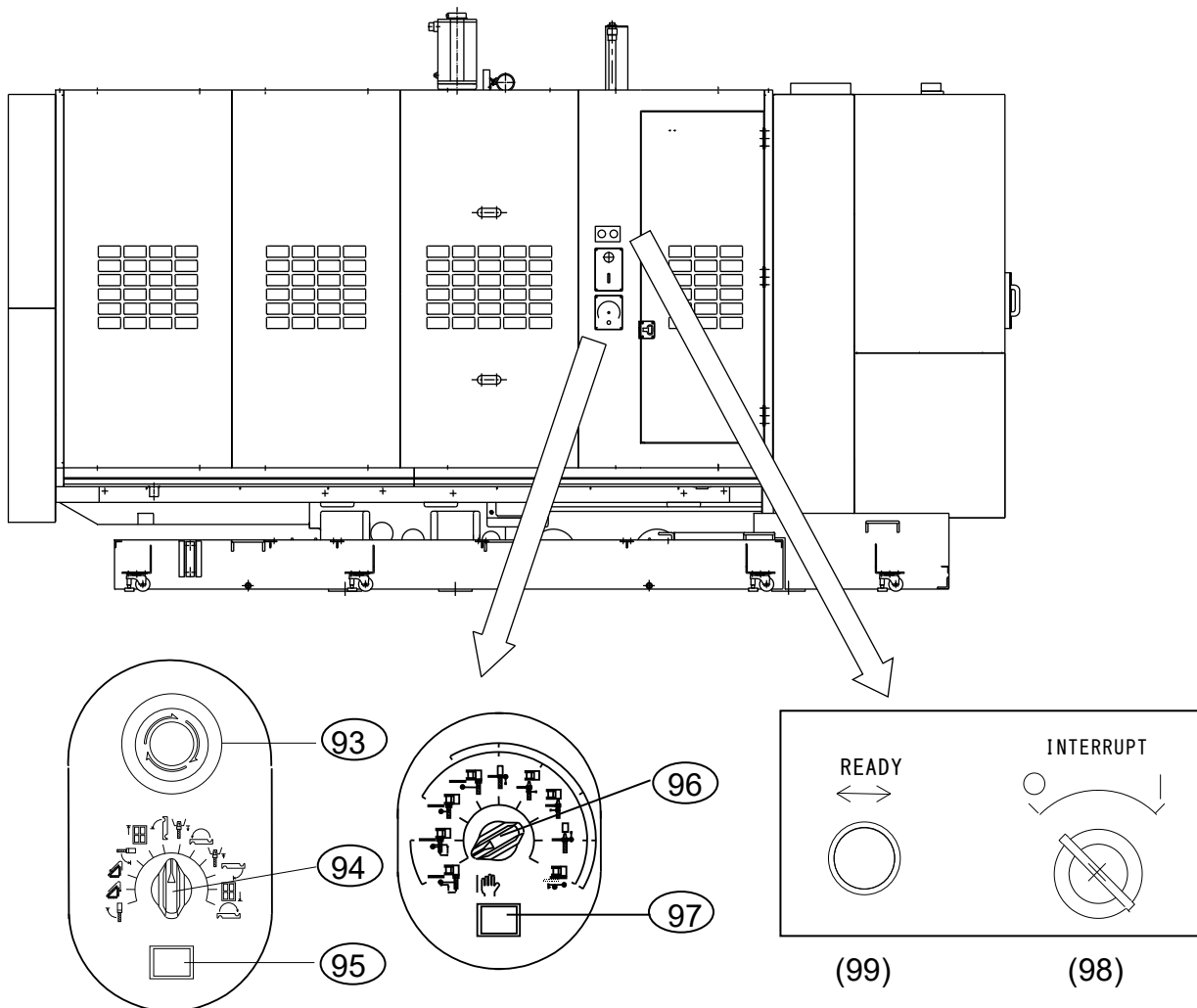
(99) Manual Interrupt Lamp



If Manual Interrupt Selection Switch (98) is set at “I” and magazine rotation/door opening operations become possible, this lamp will be lit. During automatic tool indexing operation, the lamp will blink and the electromagnetic lock will keep locked.

C. SWITCHES AND PUSHBUTTONS

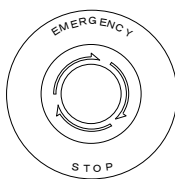
(80/120ATC)



Appellation

Function

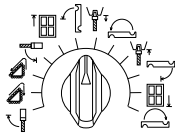
(93) Emergency Stop Pushbutton No.2 (with latch)



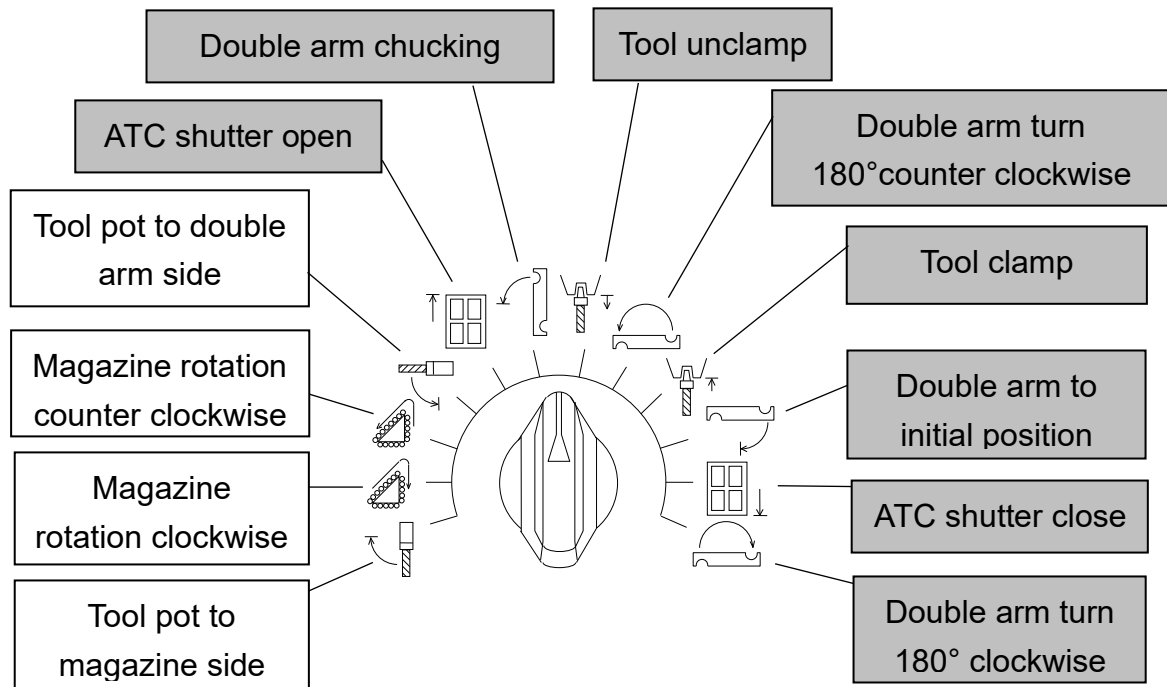
Same function as Emergency Stop pushbutton No.1 (61) on the machine operation panel. Please refer to Section C-2 (61).

C. SWITCHES AND PUSHBUTTONS

(94) ATC Manual Operation Switch



Each movement in ATC can be selected with this switch, and then executed by ATC Manual Start pushbutton (95) in JOG Mode.

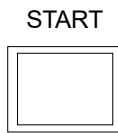


Note : There are limitations on the actions by ATC Manual Operation Select switch.

- Movements in are available only in JOG MODE and when spindle is in Tool change position.
- Movements in are available even during automatic operation if ATC magazine is stopped.
- Please refer to Chapter U of the Maintenance Manual.

C. SWITCHES AND PUSHBUTTONS

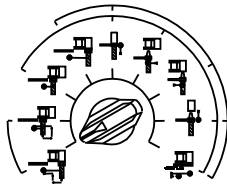
(95) ATC Manual Start Pushbutton



The ATC movement selected with the ATC Manual Operation Switch (94) is preformed by pressing this button.

Note: Be sure to close the ATC Magazine Door when rotating the tool magazine.

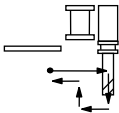
(96) Single Arm Manual Operation Switch

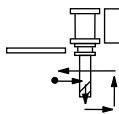


While JOG Mode is selected, Single Arm manual operation can be done by selecting operations by this switch and pressing Single Arm Manual Start Pushbutton (97).

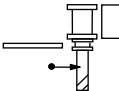
Manual continuous operation can be started in any operation mode.

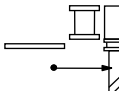
Continuous Operation

(a)  Tool from Waiting pot to Magazine pot

(b)  Tool from Magazine pot to Waiting pot


Single Operation

(c)  Tool chucking at Magazine pot

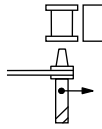
(d)  Tool chucking at Waiting pot

C. SWITCHES AND PUSHBUTTONS

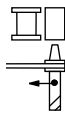
- (e)



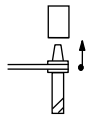
Grippers locked and Tool removed
- (f)




Single arm from Magazine pot to Waiting pot
- (g)



Single arm from Waiting pot to Magazine pot
- (h)

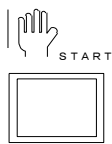


Tool inserted and Grippers unlocked
- (i)



Single arm to the initial position

(97) Single Arm Manual Start Pushbutton



Single arm manual operation selected by above switch can be started by pressing Single Arm Manual Start pushbutton (97).

Note: If you try to operate the single arm manually soon after turning the power on, it may not move properly.

This is because the hydraulic pressure is not high enough yet.

For the interruption switches (98) and (99), please see the pages of (40/60ATC).

D. STARTING AND ENDING OPERATION

D. STARTING AND ENDING OPERATION

For your safety and for machine life, be sure to check the machine before operation. (Ref. SAFETY PRECAUTIONS Section 5.)



DANGER

Damaged cable and wire can cause electric leakage or shock. Double-check that there is no damage on cable and wire. Failure to observe this warning will result in a serious personal injury or death by electric shock.

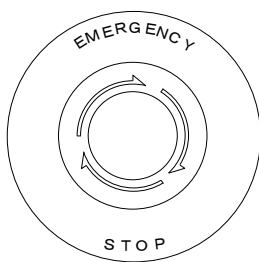
D-1 Emergency Stop

Before operation, understand how to stop operation in case of emergency.



WARNING

All personnel must know the location of EMERGENCY STOP buttons and how to use them.



EMERGENCY STOP

These Emergency Stop pushbuttons (61), (81) and (93) are effective in any mode.

Procedure

Press Emergency Stop pushbutton.

- All movements stop.
- LCD screen shows "EMG".

Note : To stop operation in normal case and to turn off power, refer to “D-4 Turning OFF Power”.

D. STARTING AND ENDING OPERATION

D-2 Turning ON Power



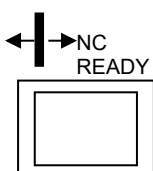
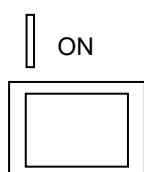
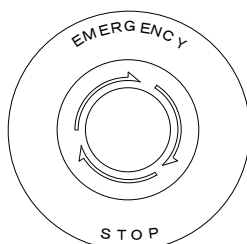
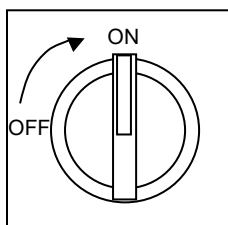
DANGER

Be sure to follow procedures instructed in this manual when turning power on/off.

Never touch any switch, button or key with wet hand.

Procedure

1. Supply electric power to the factory.
2. Turn on Main Power switch on the electric box.
 - Power Lamp on the electric box and Main Power lamp (62) on the operation panel are lit.
 - Ventilation fans in the electric box are turned on.
 - Spindle motor fan is turned on.
3. Release all Emergency Stop pushbuttons (61), (81) and (93).
4. Press NC ON pushbutton (56).
 - The lamp lights up.
 - The LCD screen shows the information on System Configuration and NC is powered.
5. Keep pressing NC Ready pushbutton (58) for a few seconds.
 - The lamp lights up.
 - The machine gets ready for operation.



Note: This machine is equipped with a weekly timer for turning the machine on/off automatically. Please refer to Section D-7.

D. STARTING AND ENDING OPERATION

Check points after turning on power:

Check point	Check item	Reference
Motors	No abnormal noise or heat?	
Air unit	Normal air pressure? (0.4~0.5MPa)	
Hydraulic unit	Normal pressure? (5.0MPa) Enough oil?	
Coolant tank	Pumps working? Enough coolant fluid?	
LCD screen	No alarm display?	
Operation panel	Oil alarm lamp is not lit? Air alarm lamp is not lit?	C-2 (63) C-2 (64)

D. STARTING AND ENDING OPERATION

D-3 Warming-up Operation

Warming-up operation is necessary for minimizing the effect of heat expansion on the machine accuracy, as well as for smooth and proper operation of each system in the machine.

Note 1: On this machine, oil is automatically supplied to Spindle as well as other parts by air. However, immediately after turning on the power, the spindle bearings are not sufficiently lubricated. Therefore, if the machine has been shut off for 48 hours or more, do not rotate the spindle for 20 minutes after the NC gets ready.



CAUTION

Spindle will be damaged if it is rotated before enough oil is supplied to the spindle bearings.

Note 2: Besides good lubrication for the spindle, ball screws and linear guides, the following should also be kept in mind:

a) Warming up of oil in hydraulic circuit

When it is cold, the viscosity of oil is high and this will cause a trouble in spindle tool clamp/unclamp for example.

* Warming-up operation program also includes a program of the hydraulic unit warming-up.

b) Permeation of grease

When it is cold, grease is also hardened. For example, insufficient lubrication on the clamp pins of the double arm may lead to a chucking problem (tools thrown away).

A weekly timer is provided on the machine to solve these problems. Please refer to Section D-7 for the weekly timer.

D. STARTING AND ENDING OPERATION

Warming-up without using Weekly Timer

Prepare the machine as follows:

- 1) Empty the spindle by T99 (no tool in spindle).
[In case of machines with Single arm such as 120-tool machines, use T0 to empty the spindle.]
- 2) Put a light tool (T40; for 60-tool machines, T60; for 120-tool machines, T120) in the waiting pot.
- 3) Move the spindle to the ATC position, and perform a warm-up program as below:

The tool number for the light tool can be changed. (Please refer to the procedure at the end of this section.)

Warming-up programs O8930 and O8931 are installed in the machine at the time of shipment. If the machine has been stopped for more than 48 hours, call Program O8931 and execute. Otherwise, call Program O8930 and execute.

Procedure

1. If the machine has been stopped for less than 48 hours, execute Program O8930 as below.
 - a) Please check the following.
 - There is no one inside or around the machine.
 - There are no obstacles inside the machining area.
 - The spindle is emptied and at the ATC position.
 - Feed Rate Override switch and Rapid Rate Override pushbuttons are set appropriately.
 - b) Close all the machine doors.
 - c) Execute Program O8930.

D. STARTING AND ENDING OPERATION

The machine performs ATC to put the light tool in the spindle. Until the hydraulic unit is warmed up, the machine repeatedly performs the tool clamp and unclamp movement and ATC movement. The operation for warm-up of the spindle is started after the lubrication of the spindle bearings for 20 minutes.

Note: The machine automatically performs ATC and rotation of the spindle. Never touch inside the machine.

2. If the machine has been stopped for more than 48 hours, call Program O8931 and execute it at the step of c) mentioned above.

Note 1: The warm-up time of Program O8931 is longer than Program O8930

Note 2: When the warm-up program is finished, put the correct tools into the spindle and waiting pot.

Note 3: If the spindle is not at ATC area (within 10 mm from ATC position) at the time of Program O8930 or O8931 start, the alarm (EX 1890) will occur and the program will be finished. Please call and execute the warming-up operation program after moving the spindle to the ATC position in MDI mode.



Running the machine without proper warm-up operation can cause serious damages to the spindle and other components of the machine.

D. STARTING AND ENDING OPERATION

Tool registration of the light tool (for high-speed rotation in the warm-up program)

The tool number of the light tool for the warm-up program is registered as the max pot number of the tool magazine at the time of shipment. In case of 40-tool machines, it is “T40”. (Similarly in case of 60-tool machines, it is “T60”.) It is possible to change the tool number of the light tool which is called in the warming-up operation program if you change the value of No. 00549 as shown in the macro variables screen below to your suitable tool number.

ACTUAL POSITION

ABSOLUTE

X	0.0000
Z	0.0000
C	0.0000
Y	0.0000

MODAL

G00	G80	G13.1	F	M
G97	G67	G50.1	H	
G69	G54	G49	D	
G99	G64	G15	T	
G21	G18	G05.5	S	
G40	G69.1			
G25	G40.1	G80.5		
G22	G50.2	G80.4		

CUSTOM MACRO

NO.	DATA	NO.	DATA
00548	0.0000		
00549	60.0000		

MEM ***** 09:15:57

MACRO **COPRT** +

D. STARTING AND ENDING OPERATION

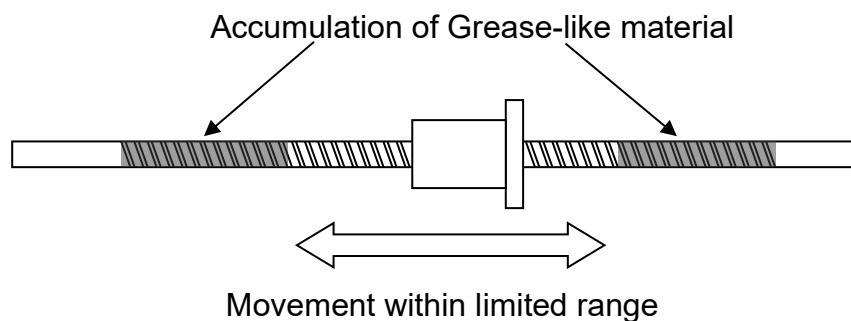
CAUTION

If only one same type of workpieces are machined continuously, the machine's moving range will be limited. If such a condition is kept for a long time, the unused part of the ballscrews/linear guides can get rusted for lack of lubrication.

Moreover, in case water-soluble coolant is used, coolant attached to the unused part of the ballscrews/linear guides/slide covers can produce grease-like high-viscosity material on their surfaces.

If the axes happen to move into this area, the grease-like material including dust and chips enters inside these components to cause serious damages to them.

To prevent such a situation, be sure to **perform a couple of times of full-stroke operation on all the axes at a low speed every three days**. By this, the unused areas of the components are cleaned and, if applicable, lubricated to prevent above problems.



D. STARTING AND ENDING OPERATION

When using the machine after a long time of rest

If the machine has been at rest for a long time, coolant fluid on moving components can get hardened and cause trouble.

1) Slide Covers

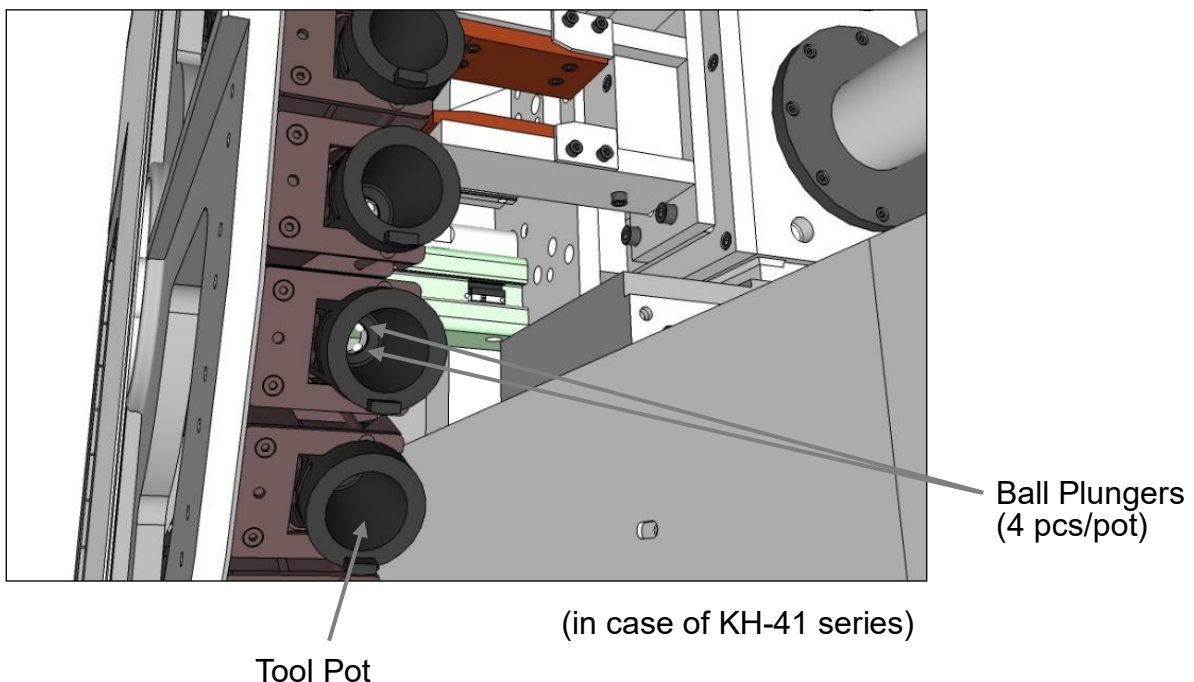
If a slide cover with hardened material sticking to it is forcefully moved suddenly, the slide cover and its wipers may be broken.

When using the machine for the first time in a long time, be sure to check the condition of its slide covers and move them slowly at first.

2) Tool Pots

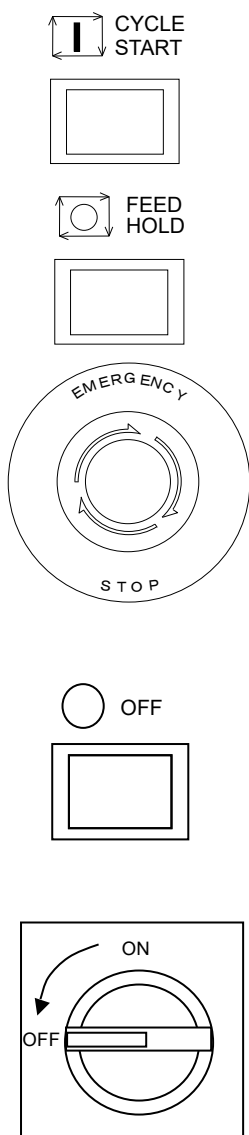
If the machine has a pot type tool magazine, the pots have ball plungers consisting of steel balls and springs. If coolant attached to the plungers gets hardened, the balls will stick to their holes and it will be difficult to pull out a tool.

When using the machine for the first time in a long time, be sure to check the condition of the ball plungers, and if necessary, clean and lubricate them.



D. STARTING AND ENDING OPERATION

D-4 Turning OFF Power



Procedure

1. Make sure that the lamp of Cycle Start pushbutton (70) is off.
If the lamp of Cycle Start pushbutton (70) is lit, press Feed Hold pushbutton (71).

2. Press Emergency Stop pushbutton No.1 (61).

Note: When Emergency Stop pushbutton (61) is pressed during editing, reading or writing on memory, registered programs may be all cleared.

3. Press NC OFF pushbutton (57).

4. Turn off Main Power switch.

Note: When using the weekly timer, do not turn off the main power switch. Electric supply will be automatically shut off at the programmed time. Refer to Section D-7.

D. STARTING AND ENDING OPERATION

D-5 After Turning OFF Power



Be sure to turn off all electric supply to the machine and to devices such as chip conveyor when cleaning them.

Notes on cleaning

- Cutting chips are transferred by coolant to the chip pan on the front side of the machine. Be sure not to keep them accumulated.
- Cutting chips attached on the covers should be rubbed off with soft brush. Never use an air gun to clean covers. Coolant and chips penetrating under cover can damage machine components such as spindle bearings and ballscrews.
- When touching cutting chips, put gloves on.

Other notes

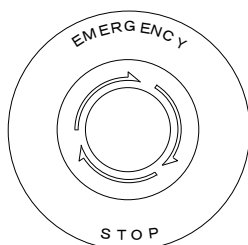
- Solenoid valves keep hot just after turning power off. Do not touch them for a while.
- When leaving the machine after operation, it should be in the same status as before operation.
- When keeping the machine stopped for a long time, insert a tool in the spindle to prevent penetration of foreign material.

D. STARTING AND ENDING OPERATION

D-6 Measures in Power Failure

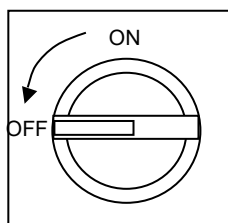
When power failure takes place during machine operation, the NC unit and electrical control units are all shut off. Consequently, all commands in the NC buffer or those given on the operation panels are completely cleared and the machine is stopped in an emergency stop status.

In Power Failure



Procedure

1. Press Emergency Stop pushbutton (61).



2. Turn off Main Power switch.

After Restoration of Power

Procedure

1. Turn the power on. (Refer to “D-2 Turning ON Power”.)
2. Restore the machine condition in manual operation.



WARNING

Corrective operation after power restoration must be done all by manual operation. Otherwise, the remaining pneumatic/hydraulic motion can be made suddenly when these circuits are turned back on.

D. STARTING AND ENDING OPERATION

When turning the power on after the restoration of power, the machine condition will be as below:

Motion or condition before power failure		After power restoration
Spindle tool	Clamped	Clamped
Spindle tool	Unclamped	Clamped or Unclamped
Spindle	Rotating	Stopped
Spindle	Stopped	Stopped
X, Y, Z, B-axis feed		Stopped at the position located at the time of power failure
ATC motion		Stopped in the motion at the time of the power failure
APC motion		Stopped in the motion at the time of the power failure

Note: To restore machine when it is stopped during ATC, refer to “U. ADJUSTMENT” of the Maintenance manual.

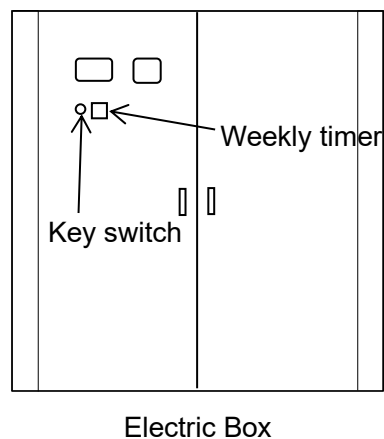
D. STARTING AND ENDING OPERATION

D-7 Weekly Timer

This machine is equipped with a weekly timer.

This weekly timer can be enabled or disabled by the key switch provided outside the main electric box door.

By using the weekly timer, the machine can be automatically turned on and off at programmed times.



If the weekly timer is used to turn on the machine, warm-up programs (installed at shipment) of the spindle and other movable components will be automatically performed.

We recommend use of the weekly timer not only for efficiency but for longer life of the machine.

D-7-1 How Weekly Timer Works

e.g. in “DAY” mode of the weekly timer (see D-7-2, 3)

ON Operation

1. At the programmed ON time, AC power is supplied to the power supply module of the machine.

Note: The key switch for the weekly timer must be set at “ON (enabled)” and the day selection switch for that day at “ON”.

2. NC is turned on.
3. The machine gets ready for operation.

D. STARTING AND ENDING OPERATION

Note: All the emergency stop buttons must be released.

4. Twenty minutes later, a spindle warm-up program (installed at factory) is started. It will take about 25 minutes to warm-up the 12,000 min⁻¹ spindle.
5. When the spindle warm-up is finished, the machine warm-up program will be started.

Note: Be sure to put back the appropriate tool in the spindle before proceeding with normal operation.

OFF Operation

1. At the programmed OFF time, the machine goes into an emergency stop status.

Note: If a program is being executed at that time, the machine will wait until it is finished, then go into an emergency stop status.

2. NC is turned off.
3. AC power supply to the power supply module is cut, but the main power switch stays ON.

Preparation for Next Operation Day

Before the programmed OFF time, perform the following:

1. Empty the spindle by T99 (no tool in spindle).
[In case of machines with Single arm such as 120-tool machines, use T0 to empty the

D. STARTING AND ENDING OPERATION

spindle.]

2. Put a light tool (T40; for 60-tool machines, T60; for 120-tool machines, T120) in the waiting pot.
3. Move the spindle to the ATC position.

Also, please check the following:

- a) the weekly timer is correctly set for the next operation day,
- b) all the emergency stop buttons are released,
- c) AUTO Mode is selected,
- d) Single block switch on the operation panel is off (its lamp not lit),
- e) there are no obstacles such as unnecessary tools inside the machining area,
- f) all the machine doors are closed (Door Open Request pushbutton is Off),
- g) feed rate override switch/pushbutton are set appropriately,
- h) the intermediate pot is positioned on the spindle side (normal position),
- i) the main power switch is ON,

Note: Do not use the Auto Power Off function; if it is used, the main power switch will be forcefully turned off.

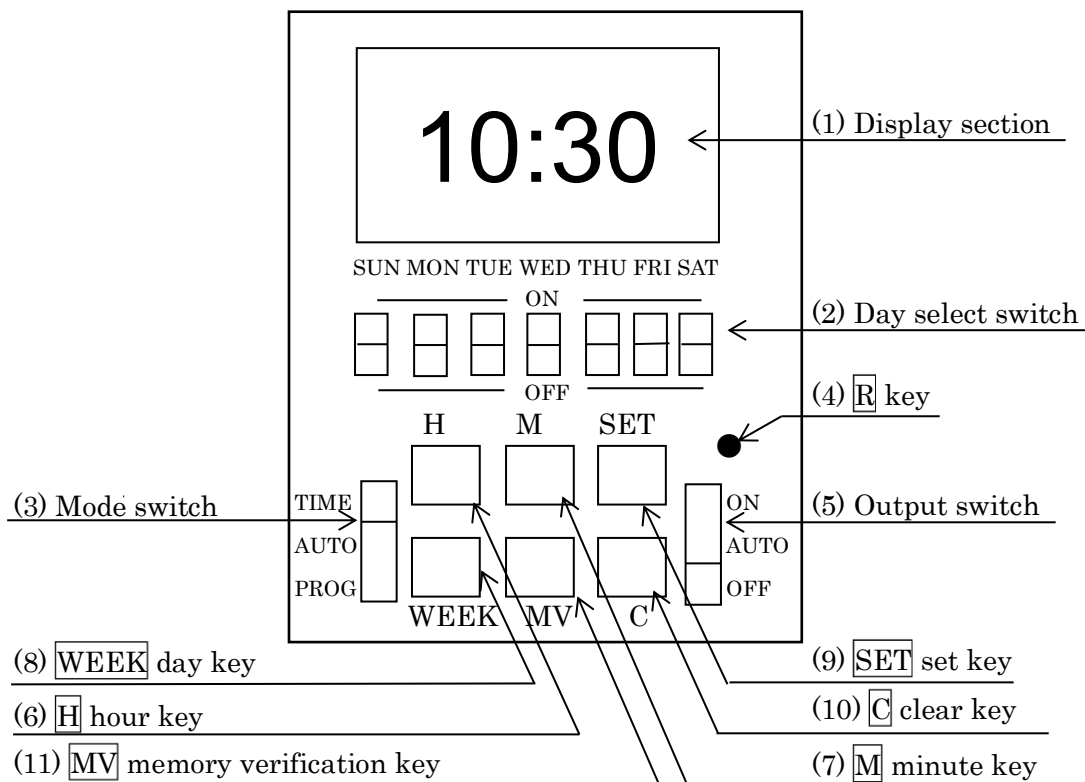
- j) the key switch for the weekly timer is ON (enabled).

Note: If the spindle is not at ATC area (within 10 mm from ATC position), the alarm (EX 1890) will occur and the program will be finished. Call and execute the warming-up operation program after moving the spindle to the ATC position in MDI mode.

D. STARTING AND ENDING OPERATION

D-7-2 How to Set Weekly Timer

Part name



Part Function

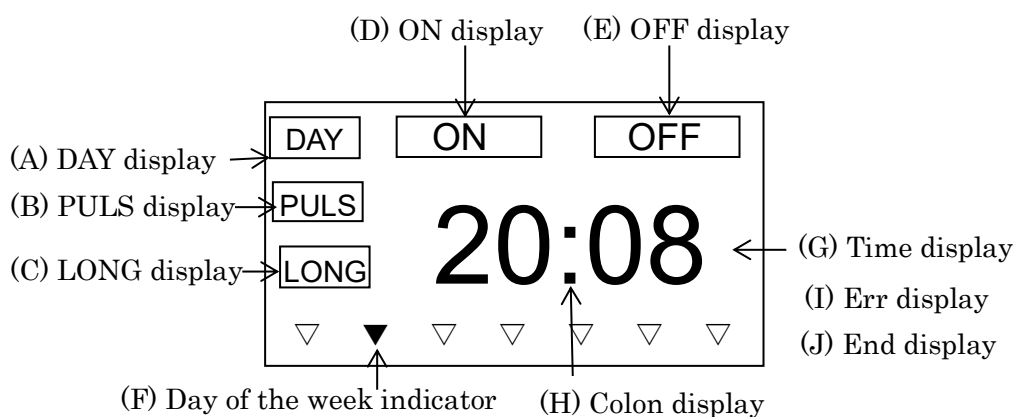
- | | |
|-----------------------|---|
| (1) Display section | Refer to the next page. |
| (2) Day select switch | For ON/OFF setting for each day. |
| (3) Mode switch | |
| - TIME(Clock) | For setting present time and day. |
| - AUTO(Automatic) | For automatic operation according to the program and day switch settings. |
| - PROG(Setting) | For setting programs. |
| (4) R key | For resetting the timer and selecting DAY, PULS or LONG. |
| - DAY(24 hours) | For setting the same operation within 24 hours daily. |
| - PULS(Pulse) | For short-time output pulse operation. |
| - LONG(Long-time) | For long-time timer operation. |

D. STARTING AND ENDING OPERATION

- (5) Output switch
- ON(Manual) For keeping output ON according to manual operation.
 - AUTO(Automatic) For automatic operation according to the set program and day switch settings.
 - OFF(Off) For keeping output OFF.
- (6) **[H]** hour key For setting present time and program time.
- (7) **[M]** minute key For setting present time and program time.
- (8) **[W]** day key For setting days of the week.
- (9) **[SET]** set key For completing the program setting.
- (10) **[C]** clear key For erasing programmed time.
- (11) **[MV]** memory verification key For checking programmed time.

* **[H]** **[M]** **[W]** and **[MV]** keys can be advanced continuously (by pressing longer than 1 second).

Display Section



- (A) DAY display Appears when the same operation within 24 hours is set daily.
- (B) PULS display Appears when short-time pulse operation is set.
- (C) LONG display Appears when long-time timer operation is set.
- (D) ON display Appears when setting for ON and output is ON.

D. STARTING AND ENDING OPERATION

- | | |
|-------------------|---|
| (E) OFF display | Appears when setting for OFF and output is OFF. |
| (F) Day indicator | Indicates the present day and programmed day when checking. |
| (G) Time display | Displays the present time and programmed time when checking. |
| (H) Colon display | Appears at one-second intervals. |
| (I) Err display | Appears when program is not set properly. |
| (J) End display | Appears when number of operations in the set program exceeds 16 for DAY setting, 31 for PULS setting and 16 for LONG setting. |

-Partial erasure If a preset time is not necessary while checking by using the MV (memory verification) key, it can be erased by pressing the C (clear) key while it is displayed.

- Total erasure The preset program is all erased by pressing the C (clear) key while pressing the SET (set) key.

- Setting additional program After checking by using the MV (memory verification) key, - - : - - appears. Then an additional program can be set by using the H and M keys.




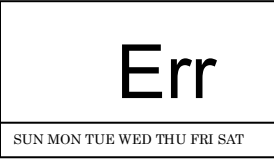
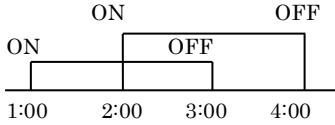
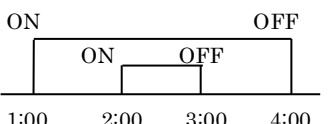

MV → MV → MV

- - : - - (Set additional times in this state.)




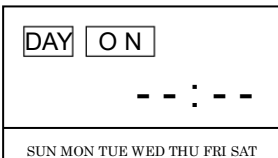
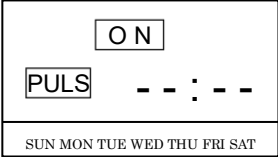
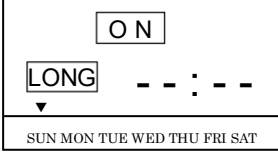
D. STARTING AND ENDING OPERATION

1

Err Display

Mode Switch	Display	Program Example
TIME  AUTO  PROG 	 SUN MON TUE WED THU FRI SAT	 One "ON" time overlaps another.
		 One "ON" time falls within another.
		 "ON" and "OFF" are not set as a pair.

Setting R key

Mode Switch	Order	Display	Key Operation
TIME  AUTO  PROG 	1	 SUN MON TUE WED THU FRI SAT	Ⓡ Press the R key with a pen tip or the like by 1 second at a time till DAY appears in the display.
	2	 SUN MON TUE WED THU FRI SAT	Press the R key by 1 second at a time till PULS appears in the display.
	3	 SUN MON TUE WED THU FRI SAT	Press the R key by 1 second at a time till LONG appears in the display.




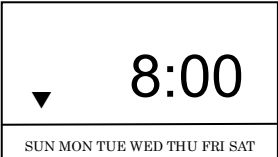
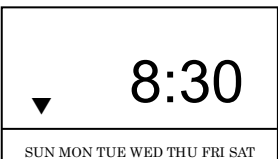
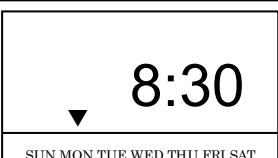



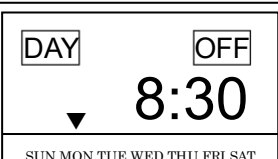
- * - Pressing the R key will erase the preset program.
- Pressing the R key for 2 seconds or longer will erase both present time and preset program.

D. STARTING AND ENDING OPERATION

2

Setting Present Time

(Example) When setting 8:30 a.m. on Monday as the present time.

Mode Switch	Order	Display	Key Operation
TIME  AUTO  PROG 	1		Press the [H] key till [8] appears in the hour position in the time display.
	2		Press the [M] key till [30] appears in the minute position in the time display.
	3		Press the [WEEK] key till the indicator on [MON] lights and press the [SET] key.
TIME  AUTO  PROG 	4		The present time is displayed.

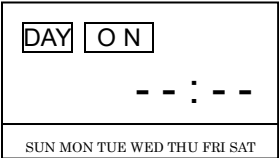
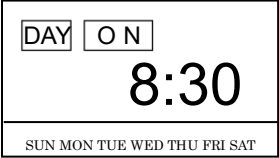
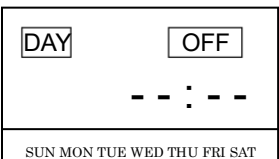
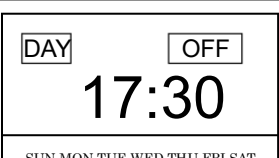
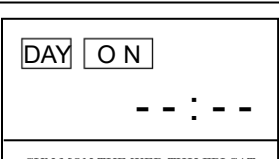

* The internal second counter starts at “00” when SET key is pressed and released.

D. STARTING AND ENDING OPERATION

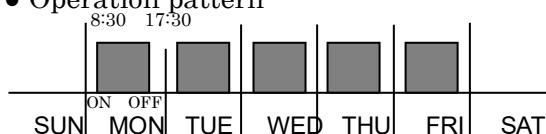
3

Setting For Same Operation Within 24 hours Daily.

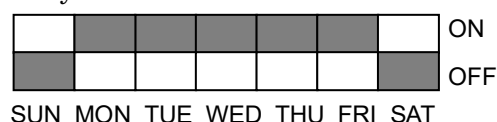
(Example) When setting ON at 3:30 a.m. and OFF at 5:30 p.m. from Monday to Friday.

Mode Switch	Order	Display	Key Operation
TIME <input type="checkbox"/> AUTO <input type="checkbox"/> PROG <input checked="" type="checkbox"/>	1		Select the DAY mode.
	2		Press the H key till 8 appears in the hour position and then the M key till 30 appears in the minute position in the time display.
	3		Pressing the SET key completes the ON time setting.
	4		Press the H key till 17 appears in the hour position and then the M key till 30 appears in the minute position in the time display.
	5		Pressing the SET key completes the OFF time setting. * Upon completion of the program setting, be sure to check the program by using the MV key. - When a setting has not been done properly or needs to be changed, it can be erased by pressing the C key while it is on display. Then reset as desired properly. - Pressing the SET and C keys simultaneously will erase all programs in memory.
TIME <input type="checkbox"/> AUTO <input checked="" type="checkbox"/> PROG <input type="checkbox"/>			- The present time is displayed. - When "Err" appears, it means that the program is not set properly. Refer to 1.

• Operation pattern



• Day select switches



D. STARTING AND ENDING OPERATION




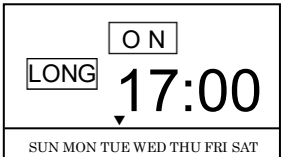
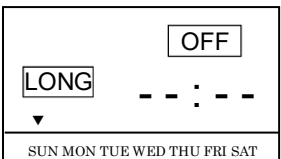
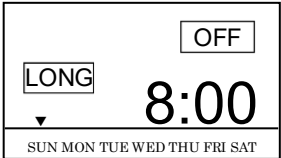
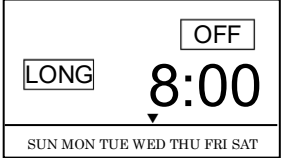
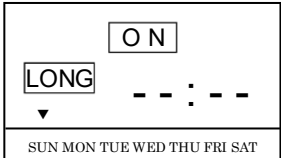



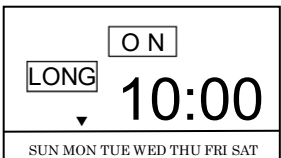
4

Setting for Different Operation for Each Day

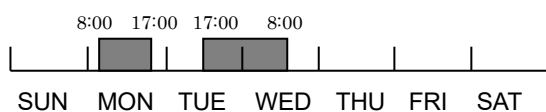
(Example) When setting ON 8:00 a.m. and OFF at 5:00 p.m. on Monday and again ON at 5:00 p.m. on Tuesday and OFF at 8:00 a.m. on Wednesday.

Mode Switch	Order	Display	Key Operation
<div style="display: flex; align-items: center;"> <div style="margin-right: 10px;"> TIME AUTO PROG </div> <div style="border: 1px solid black; width: 20px; height: 20px; display: flex; flex-direction: column; align-items: center;"> <div style:="width: 100%; height: 100%; background-color: white;"></div> <div style:="width: 100%; height: 100%; background-color: white;"></div> <div style:="width: 100%; height: 100%; background-color: black;"></div> </div> <div style:="margin-left: 10px;">↓</div> </div>	1	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <div>OFF</div> <div>LONG - - : - -</div> <div style="font-size: small;">SUN MON TUE WED THU FRI SAT</div> </div>	Select the LONG mode.
	2	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <div>ON</div> <div>LONG 8:00</div> <div style="font-size: small;">SUN MON TUE WED THU FRI SAT</div> </div>	Press the H key till 8 appears in the hour position in the time display.
	3	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <div>ON</div> <div>LONG 8:00</div> <div style="font-size: small;">SUN MON TUE WED THU FRI SAT</div> </div>	Press the WEEK key till the day indicator on MON lights.
	4	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <div>OFF</div> <div>LONG - - : - -</div> <div style="font-size: small;">SUN MON TUE WED THU FRI SAT</div> </div>	Press the SET key, and the ON time is set.
	5	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <div>OFF</div> <div>LONG 17:00</div> <div style="font-size: small;">SUN MON TUE WED THU FRI SAT</div> </div>	Press the H key till 17 appears in the hour position in the time display.
	6	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <div>OFF</div> <div>LONG 17:00</div> <div style="font-size: small;">SUN MON TUE WED THU FRI SAT</div> </div>	Press the WEEK key till the day indicator on MON lights.
	7	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <div>ON</div> <div>LONG - - : - -</div> <div style="font-size: small;">SUN MON TUE WED THU FRI SAT</div> </div>	Press the SET key, and the OFF time is set.
	8	<div style="border: 1px solid black; padding: 5px; text-align: center;"> <div>ON</div> <div>LONG 17:00</div> <div style="font-size: small;">SUN MON TUE WED THU FRI SAT</div> </div>	Press the H key till 17 appears in the hour position in the time display.

D. STARTING AND ENDING OPERATION

Mode Switch	Order	Display	Key Operation
TIME  AUTO  PROG 	9		Press the WEEK key till the day indicator on TUE lights.
	10		Press the SET key, and the ON time is set.
	11		Press the H key till 8 appears in the hour position in the time display.
	12		Press the WEEK key till the day indicator on WED lights.
	13		Press the SET key, and the OFF time is set.
*Upon completion of program setting, check the program content by using the MY key. - When a setting has not been done properly or needs to be changed, it can be erased by pressing the C key while it is on display. Then reset as desired properly. - Pressing the SET and C keys simultaneously will erase all programs in memory.			
TIME  AUTO  PROG 			- The present time is displayed. - If Err appears, it means that the program is not set properly. Refer to 1 .

● Example of Operation Pattern



Note: The day select switch cannot be used when setting different operation for each day.

D. STARTING AND ENDING OPERATION

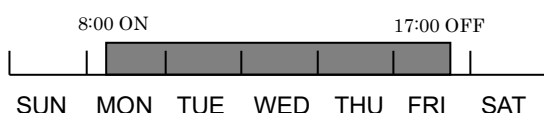
5

Setting for Long-Time Operation

(Example) When setting ON at 8:00 a.m. on Monday and OFF at 5:00 p.m. on Friday.

Mode Switch	Order	Display	Key Operation
TIME <input type="checkbox"/> AUTO <input type="checkbox"/> PROG <input checked="" type="checkbox"/>	1		Select the LONG mode.
	2		Press the H key till 8 appears in the hour position and then press the WEEK key till the day indicator on MON lights in the display.
	3		Press the SET key, and ON time is set.
	4		Press the H key till 17 appears in the hour position and then press the WEEK key till the indicator on FRI lights in the display.
	5		Press the SET key, and OFF time is set. * Upon completion of the program setting, check the program content by using the MV key. - When a setting has not been done properly or needs to be changed, it can be erased by pressing the C key while it is on display. Then reset as desired properly. - Pressing the SET and C keys simultaneously will erase all programs in memory.
TIME <input type="checkbox"/> AUTO <input checked="" type="checkbox"/> PROG <input type="checkbox"/>			- The present time is displayed. - If Err appears, it means that the program is not set properly. Refer to 1 .

• Example of Operation Pattern



Note: The day select switch cannot be used for long-time operation

E. MANUAL OPERATION

E. MANUAL OPERATION

E-1 Zero Point Return

An absolute type encoder is used for positioning of each axis on this machine, so usually there is no need to execute zero point return after turning power on the machine. However, if a servo motor loses its zero point data for some reason such as low batteries, execution of zero point return will be necessary for all axes.

Procedure

Zero point return procedures are different between XYZ axes and B axis.

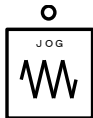
(Please refer to Section U-6 of Maintenance manual)

E. MANUAL OPERATION

E-2 JOG Feed

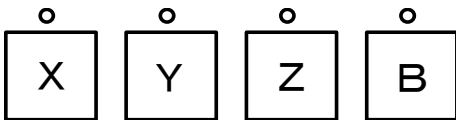
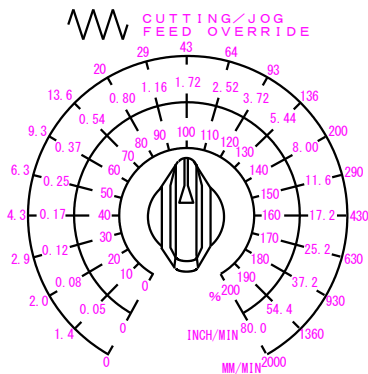
JOG feed is to move each axis continuously at a jog feed rate in manual operation.

Twenty-one speeds can be selected from 0 to 2,000 mm/min. on X, Y and Z axes and 0 to 2000° /min. on B axis.



Procedure

1. Press JOG Mode pushbutton (6). The lamp will be lit. Machine is in JOG mode.

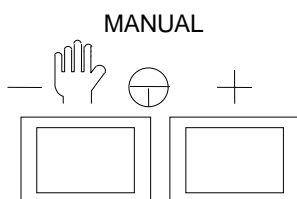


2. Set a required feedrate by the outer scales of Feed Rate Override and JOG Feed Setting switch (69).

3. Select an axis to move with Axis Selection pushbutton (25), (26), (27) or (28). In case of B-axis (28), B-axis Unclamp pushbutton (48) must also be pressed.

4. Press either Minus/Plus Direction Feed pushbutton (77) or (78).

As long as the pushbutton (77) or (78) is pressed, the selected axis moves at the selected feedrate.



Note: “Overtravel” alarm is displayed on the LCD when overtravel values are commanded. Axis itself doesn’t exceed its travel area in both automatic and manual modes.

To release it:

move the axis in the opposite direction from the overtravel in manual operation, then press RESET button.

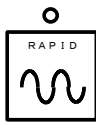
E. MANUAL OPERATION

E-3 Rapid Traverse

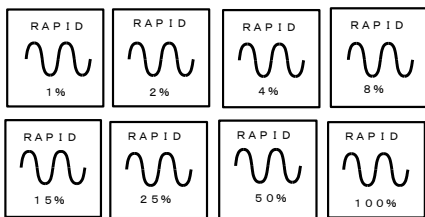
Rapid traverse is to move each axis continuously at a rapid traverse rate.

Override of 1, 2, 4, 8, 15, 25, 50 and 100% can be applied.

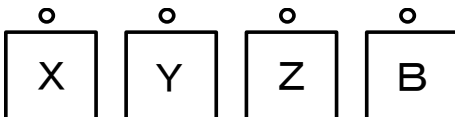
Procedure



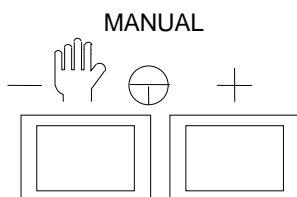
1. Press RAPID Mode pushbutton (7). The lamp will be lit.



2. Select an appropriate rapid feed rate by Rapid Feed Override pushbuttons (29) to (36).



3. Select an axis to move by Axis Selection pushbuttons (25) to (28).



4. Press either Minus/Plus Direction Feed pushbutton (77) or (78).

* As long as the pushbutton (77) or (78) is pressed, the selected axis moves at the selected rapid traverse rate.

Note: When overtravel occurs, refer to “E-2 JOG Feed”.

E. MANUAL OPERATION

E-4 Handle Feed

Handle feed is to move each axis little by little using the Manual Pulse Generator (79). Feed rate of 0.1, 0.01 or 0.001 mm/scale is available on X, Y and Z axes, and 0.1° , 0.01° or 0.001° on B axis by using Manual Pulse Generator (79). One rotation of its handle equals 100 scales. The handle should be rotated slower than 5 rotations/sec.



Procedure

1. Press HANDLE Mode pushbutton (5). The lamp will be lit.
2. Select $\times 1$ (0.001mm), $\times 10$ (0.01mm) or $\times 100$ (0.1mm) by Handle Feed Selection Switch on Manual Pulse Generator (79).
3. Select an axis to move by Axis Selection Switch on Manual Pulse Generator (79).
The pushbuttons (25) to (28) on Operation Panel are ineffective, but a lamp of the selected axis will be lit.
4. Turn the handle of Manual Pulse Generator (79) as required. The selected axis is moved by the selected amount according to the handle turn.

Note 1: When overtravel occurs, refer to “E-2 JOG Feed”.

Note 2: Manual Pulse Generator is effective only in HANDLE Mode.

Note 3: Manual Pulse Generator is effective only when the enabling switch is pressed to the middle position while the operator door is open.

E. MANUAL OPERATION

E-5 Setting/Taking off Spindle Tool



WARNING

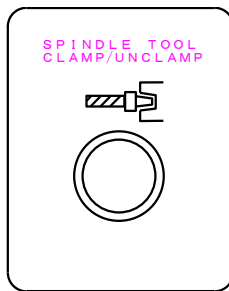
Always keep away from the rotating spindle.

1. Move Spindle Head toward the operator side by handle feed.
2. Press Door Open Request button (65) to light its lamp ON.
3. Open the operator side door.

4. Follow the procedures below in JOG mode:

Tool removal

Holding the spindle tool firmly by hand, press Spindle tool clamp/unclamp button (60) on Operation panel (the lamp will be lit). The tool is unclamped, and can be removed from Spindle.



Tool setting

Press Spindle tool clamp/unclamp button (60) on Operation panel (the lamp will be lit). Insert a tool into Spindle, and press Spindle tool clamp/unclamp button (60) again. The lamp goes off, and the tool is clamped in Spindle.

Note 1: Be sure to hold the spindle tool by hand before pressing this button to unclamp it.

Note 2: When pressing the button, keep pressing it securely for more than one second. Otherwise, the button will not work.

Note 3: Do not touch the cutting edge of tools by hand.

Note 4: When Spindle is in unclamp status, it can not accept rotation and orientation commands.

E. MANUAL OPERATION

E-6 Spindle Revolution and Stop



WARNING

Always keep away from the rotating spindle.

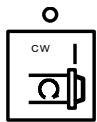


CAUTION

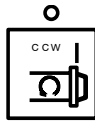
Do not rotate the spindle without a tool in it. Rotating the empty spindle at a high speed may damage inner parts of the spindle.



1. Press JOG Mode pushbutton (6). The lamp will be lit.



or



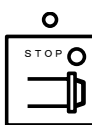
2. Press Spindle CW Rotation pushbutton (41), or Spindle CCW Rotation pushbutton (43).



or



To change spindle speed, override of 50% to 150% is available with Spindle Speed Deceleration pushbutton (44) or Spindle Speed Acceleration pushbutton (46).



3. Press Spindle Stop pushbutton (42).
The spindle will stop.

Note 1: Spindle Stop pushbutton (42) is effective in HANDLE, RAPID mode as well as JOG mode.

Note 2: The spindle rotates at the speed commanded by the address "S" most recently in MDI or AUTO mode. If MDI or AUTO operation has not been executed after the power was turned on, the spindle will not rotate. Command a spindle speed in MDI mode, and then rotate the spindle.

F. MDI OPERATION

F. MDI OPERATION

F-1 MDI (Manual Data Input) Operation

Command of multiple blocks can be inputted through LCD/MDI panel to MDI operation buffer memory.

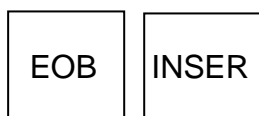
Procedure

1. Press MDI Mode pushbutton (4). The lamp will be lit and the MDI screen will be displayed on the LCD.

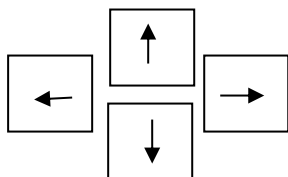
* **If other screen is displayed, press [PROG] key of function keys or MDI soft key.**



2. Input commands.

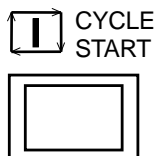


3. Press [EOB] key, then [INSERT] key.



4. Move the cursor to the top of the program or to the position to start operation.

* **Program starts from the top of block where the cursor is.**



5. Press Cycle Start pushbutton (70).

F. MDI OPERATION

Note 1: On the LCD screen, one page of program (up to 10 blocks) can be made and performed in the same manner as the normal program.

To stop the program half way, press Feed Hold pushbutton (71) .

Note 2: Program No. "O0000" is automatically inserted for the program made this way.

Note 3: To clear the program made on the LCD, input "O" then press [DELETE] key. By parameter setting, [RESET] key can clear the program.

Note 4: Regardless of the cursor position, program starts from the top of the block immediately after entering a program. After that, however, it will start from where the cursor is located.

Note 5: Sub-program can be called, but not Macro-program.

Note 6: MDI operation is available only when program memory has capacity.

Note 7: MDI program is automatically deleted after reaching "%".

However, MDI program is not deleted performing M02, M30 or M99.

Note 8: MDI program is deleted in the following cases:

- when EDIT Mode pushbutton (1) is pressed to edit a program,
- when background editing is done, or
- when automatic operation is started.

F. MDI OPERATION

F-2 Spindle Revolution in MDI



WARNING

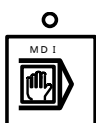
Always keep away from the rotating spindle.



CAUTION

Do not rotate the spindle without a tool in it. Rotating the empty spindle at a high speed may damage inner parts of the spindle.

Procedure



1. Press MDI Mode pushbutton (4). The lamp will be lit. Machine is in MDI mode.



2. Press [PROG] key on NC operation panel.

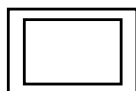
3. For spindle speed command, key-in [S], required spindle speed, then [INSERT] Key.

4. For rotation command, key-in "M03" (Forward) or "M04" (Reverse), and [EOB], then [INSERT].

ex.) To rotate the spindle at 600 min⁻¹ forward, enter:

[S][6][0][0][INSERT]

[M][3][EOB][INSERT]



5. Press Cycle Start pushbutton (70). Spindle will rotate at the commanded speed in the commanded direction.

Note 1: During ATC operation, spindle revolution is not effective.

Note 2: While the spindle tool is unclamped, spindle revolution is not effective.

F. MDI OPERATION

F-3 Spindle Orientation in MDI

Procedure

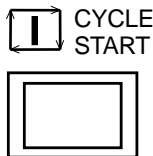


1. Press MDI Mode pushbutton (4). The lamp lights on. Machine is in MDI mode.



2. Press [PROG] key on NC Key Board.

3. Key-in "M19" (orientation), [EOB], and [INSERT].



4. Press Cycle Start pushbutton (70).

Note 1: Orientation (holding of the spindle in a fixed position) can not be executed when the spindle is unclamped.

Note 2: Orientation is released when ATC movements are completed and spindle revolution is commanded.

F. MDI OPERATION

F-4 ATC Magazine Indexing and Tool Change



Procedure

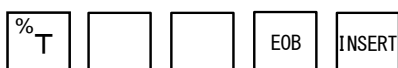
1. Press MDI pushbutton (4) to light the lamp on.
2. Register tools. Please refer to "H-2 Tool Registration".
3. Press [PROG] key on NC Key Board.



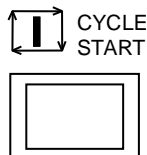
4. Key in the tool No. to be indexed.

ex.) To index tool No.1

Press [T] [0] [1] [EOB] [INSERT] in this order.



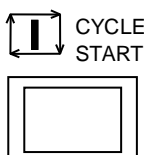
5. Press Cycle Start pushbutton (70). Commanded tool will be indexed at ATC position.



6. For ATC, move spindle head to ATC position. (Refer to "H-3 Tool Exchange in MDI Operation".)



7. Key in [M] [6] [EOB] [INSERT] .



8. Press Cycle Start pushbutton (70). The spindle tool will be exchanged with the indexed tool.

Note: Please command "T**" and "M6" in different blocks.

F. MDI OPERATION

F-5 Table Clamp/Unclamp in MDI Operation

M61 commands B axis (for Table rotation) to be clamped, and M62 and M63 command it to be released (unclamped).

M61

This is a single command for B-axis clamping.

M62

When this is commanded in MDI mode, B-axis rotary table will be unclamped, and it will be automatically clamped again after B axis is rotated.

This Auto-clamp function works also in AUTO/ REMOTE operation in the same way as in MDI mode.

Note: When B axis is stopped due to Feed Hold, it remains unclamped.

M62 is effective for one table rotation command only.

M63

M63 is a single command for B-axis unclamping.

M63 doesn't execute Auto-clamp function even after B axis is rotated.

To clamp B axis after M63, M61 is to be commanded separately, or M62 is to be commanded in the same block of table rotation command.

F. MDI OPERATION

Note: After the table is unclamped by M63, machining can be done with the table in unclamped status. However the accuracy will be inferior to the table clamped status. For heavy cutting and/or accurate cutting, be sure to clamp the table.

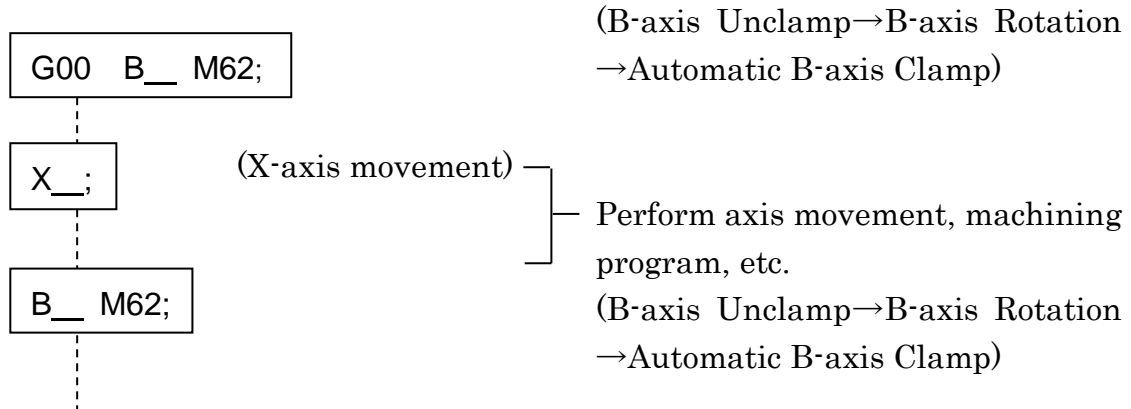
Remarks

- 1) In Handle Feed or Rapid mode, pressing B- axis Selection pushbutton (28) makes B axis unclamped. In this condition:
 - a) if you go into Auto mode or MDI mode, B axis will be clamped again, but,
 - b) if you go into JOG mode or Zero Return mode, B axis will remain in an unclamped condition.
- 2) In JOG or Zero Return mode, just pressing B-axis Selection pushbutton (28) does not make B axis unclamped.

F. MDI OPERATION

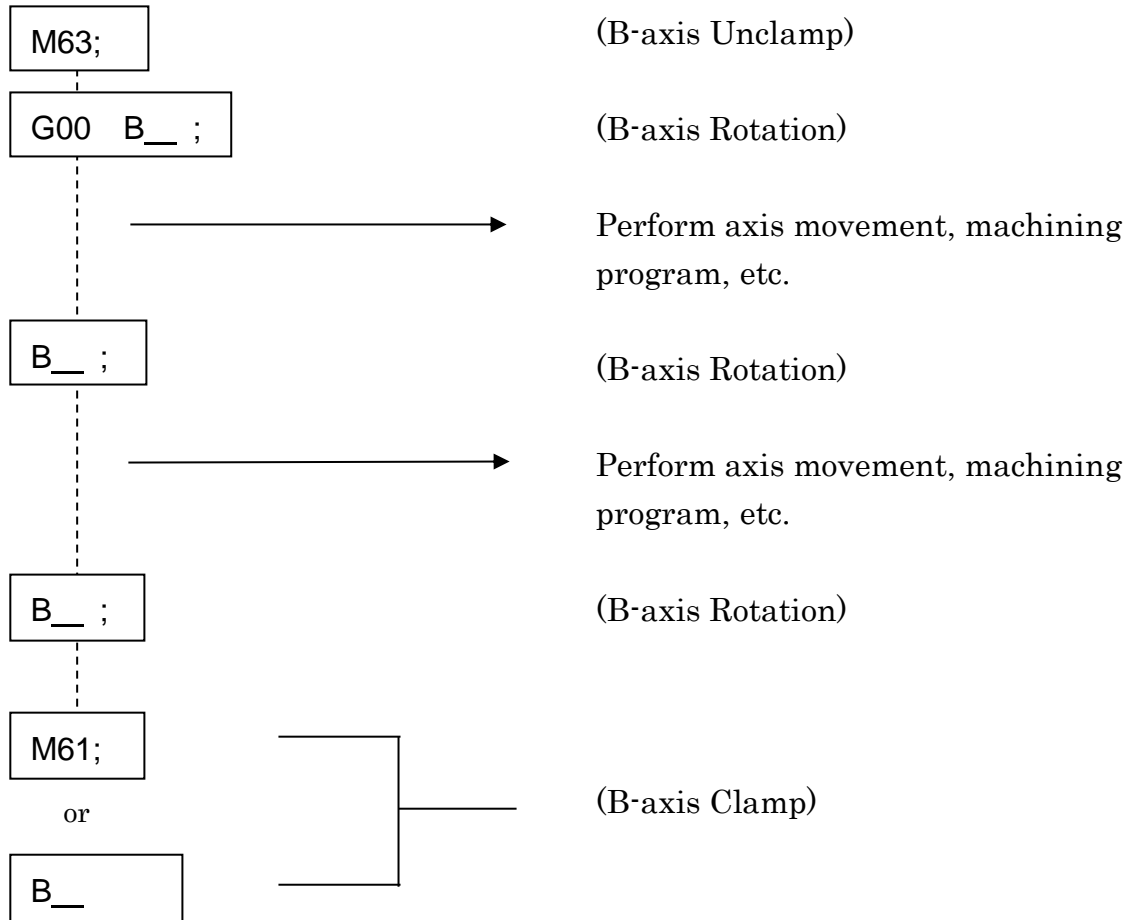
Examples of Program

1. Using M62



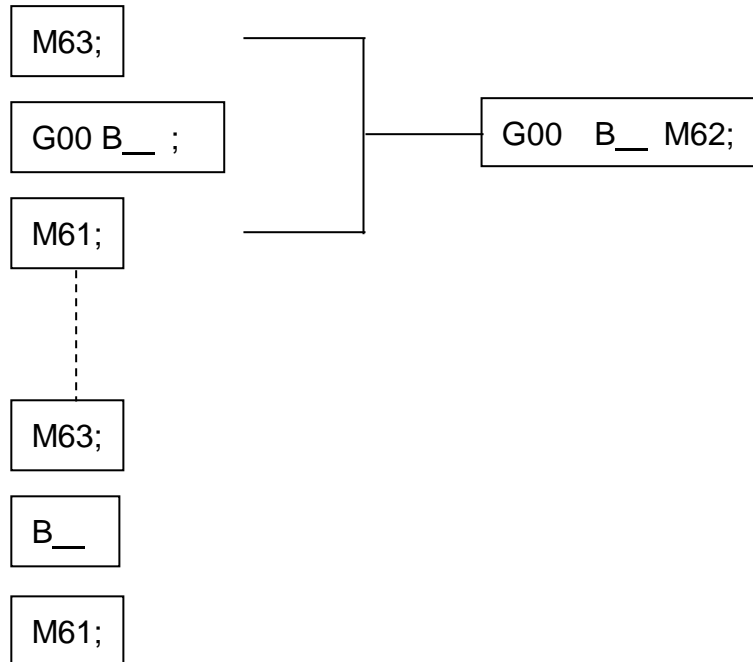
2. Using M61 and M63

(1)



F. MDI OPERATION

(2)



To perform movement of (B-axis Unclamp → B-axis Rotation → B-axis Clamp), programming (G00 B__ M62 ;) will be more convenient than the program at left.

G. AUTOMATIC OPERATION

G. AUTOMATIC OPERATION



WARNING

1. Before automatic operation
 - a) Check that the program is correctly entered.
 - b) Check that all switches and pushbuttons are correctly set. (Especially for Dry run, Override, Coolant ON/OFF, etc.)
 - c) Check that all doors are closed and that all covers are properly set.
 - d) Check that no part of human body is and will be in the machine movable area.
 - e) Check that no interference is and will be made between tools and workpieces or fixtures.
 - f) Be sure to avoid all possibility that may cause fire.
2. During automatic operation
 - a) Never open any door nor any cover.
 - b) Be sure that someone can reach Emergency stop pushbuttons any time in case of emergency.
3. After automatic operation
 - a) When opening any door or any cover, double check that the automatic operation is stopped, and that all movements are completely stopped.
4. When any alarm occurs
 - a) When the machine is stopped for any unexpected reason, be sure to remove the cause of the stop before restarting the operation.

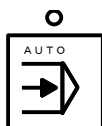
Failure to observe these warnings can result in a serious personal injury or give a serious damage to the machine.

G. AUTOMATIC OPERATION

G-1 Starting Automatic Operation

(1) Memory Operation (AUTO)

Procedure

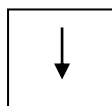
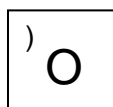


1. Press AUTO Mode pushbutton (2) to light the lamp on.

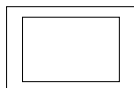


2. Press [PROG] key.
The program edit screen will be displayed on the LCD.

Address key Numerical key



3. Call the program to be executed in the following way:
 - i) Press address key [0].
 - ii) Key in the program number with numerical keys. For example, press [0], [1], [2] and [3] or just [1], [2] and [3] for Program No. 0123.
 - iii) Press cursor key.
The program will be displayed on the LCD.
 - iv) Press [RESET] key.



4. After checking that the displayed program is the correct one, press Cycle Start pushbutton (70).
Its lamp will be lit, and the called program started.

G. AUTOMATIC OPERATION

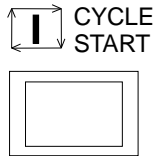
(2) Remote Mode Operation

Procedure

1. Set a tape reader or a program transfer device to the RS232C interface so that program output is available.



2. Press REMOTE Mode pushbutton (3) to light on the lamp.



3. Press Cycle Start pushbutton (70).

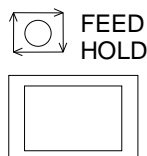
Its lamp will be lit, and the program will be read, but the blocks being executed are not displayed on the screen.

Note: Prior to Remote mode operation, please read instruction manuals of the transfer device.

G. AUTOMATIC OPERATION

G-2 Stopping and Restarting Automatic Operation

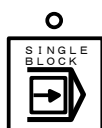
(1) Feed Hold (Halt)



Press Feed Hold pushbutton (71), and the operation will come to a temporary stop. Please refer to “C-2 Operation Panel of Machine (71)”.

- Feed Hold lamp lights up and the lamp of Cycle Start pushbutton (70) goes off.
- All the movements are decelerated and stop.
- The dwell execution is halted.
- M code command and S code command are executed, then the machine stops.
- Feed Hold does not stop the spindle revolution, nor coolant flow.

(2) Single Block Stop



Press Single Block pushbutton (9), and the operation will stop after executing one block. Please refer to “C-2 Operation Panel of Machine (9)”.

- When operation stops, lamp of Cycle Start pushbutton (70) goes off.
- With this pushbutton (9) ON, each one press of Cycle Start pushbutton (70) executes the next one block and stops the operation.

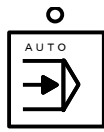
Note: When this pushbutton is ON, the machine stops at an intermediate point of G28 or G29, and at a point of the canned cycle. (Refer to FANUC's "Operator's Manual".)

G. AUTOMATIC OPERATION

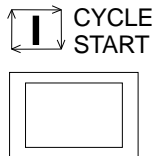
(3) Suspension of Automatic Operation

Manual operation is available while automatic operation is stopped by these pushbuttons. MDI operation is available while automatic operation is stopped by Single block.

(4) Restart of Automatic Operation



1. Press AUTO Mode pushbutton (2) to light the lamp on.



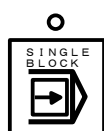
2. Press Cycle Start pushbutton (70).
(Refer to FANUC's "Operator's Manual".)

G. AUTOMATIC OPERATION

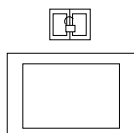
G-3 Door Safety Interlock

See the tables at the end of this section for a summary of the door interlock.

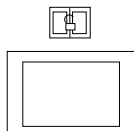
(A) Operator Side Door (LS11)



DOOR OPEN
REQUEST



DOOR OPEN
REQUEST



↔ CYCLE
START



The operator side door has safety lock (LS11). To open this door during automatic operation,

- 1) Press Single Block Pushbutton (9).
- 2) After Cycle Start Pushbutton lamp goes off, press Door Open Request Pushbutton (65).
 - Spindle automatically stops, if running.
 - Coolant fluid also stops, if running.
 - The lamp (65) is lit on.
- 3) Now, operator can open the door.

Note: It takes some time before the spindle stops completely. After its complete stop, the door can be opened.

To restart the operation,

- 1) Close the door.
 - Door Open Request lamp goes off.
 - The door is locked.
- 2) Press Cycle Start Pushbutton (70), in Auto mode.
 - Spindle and the coolant restart on. (The same status of the spindle and the coolant pump as before the interruption.)
- 3) Press Cycle Start Pushbutton (70) again.
 - The program starts from where it stopped.

Note 1: Even the main power switch is off, this safety lock works.

Note 2: The spindle restart is cancelled if Reset Button and/or Emergency Stop Pushbutton is pressed, or the power is turned off.

G. AUTOMATIC OPERATION

(B) ATC Magazine Door (LS12)

The ATC magazine door has a safety lock.

It cannot be opened when

- a) the ATC double arm (or single arm) is in motion,
- or
- b) the tool pot magazine is rotating.

The Door Open Request pushbutton is not required to open the ATC magazine door.

Note 1: When this door is open, operation of the ATC double arm, (single arm) and tool pot magazine is prohibited.

Note 2: Even the main power switch is off, this safety lock works.

(C) Set-up Doors (LS13)

The set-up doors of this machine have a safety lock.

These doors are locked only when

- a) pallet change is in process, or
- b) the lamps of Pallet Set-up pushbuttons (76) and (80) are lit on.

Note 1: While the set-up doors are open and unlocked, pallet change is unavailable, both in Auto and Manual modes. Pallet change operation should be done with these doors closed.

Note 2: Even the main power switch is off, this safety lock works.

G. AUTOMATIC OPERATION

(D) Summary of Door Interlock

○: Possible ×: Impossible

When Operator door is open

ACTION		MODE			
		Auto And MDI	Handle and Jog	Rapid	Zero return
Axis	Movement	×	○ (Note)	At 1.8m/min. (Note)	At 1.8m/min. (Note)
Spindle	Revolution	×	×		
	Tool clamp/unclamp	×	○		
ATC	Double arm	×	×		
	Tool magazine	×	○		
APC	Pallet change	×	×		
	Pallet clamp/unclamp	×	○		

Note: Only when the Door Interlock switch is set at “OFF” (Ref. Chapter C).

When ATC magazine door is open

ACTION		Auto and MDI
Axis	Movement	○
Spindle	Revolution	○
	Tool clamp/unclamp	○
ATC	Double arm	×
	Tool magazine	×
APC	Pallet change	○
	Pallet clamp/unclamp	○

When Set-up doors are open

ACTION		ALL MODES
Axis	Movement	○
Spindle	Revolution	○
	Tool clamp/unclamp	○
ATC	Double arm	○
	Tool magazine	○
APC	Pallet change	×
	Pallet clamp/unclamp	○

H. ATC OPERATION

H. ATC OPERATION

H-1 Tool Setting and Removal in ATC Magazine

Tool setting to and removal from Tool pots are done using ATC Manual Operation Switches.

Note: ATC Magazine can not be rotated while ATC magazine door is open.

How to set tools

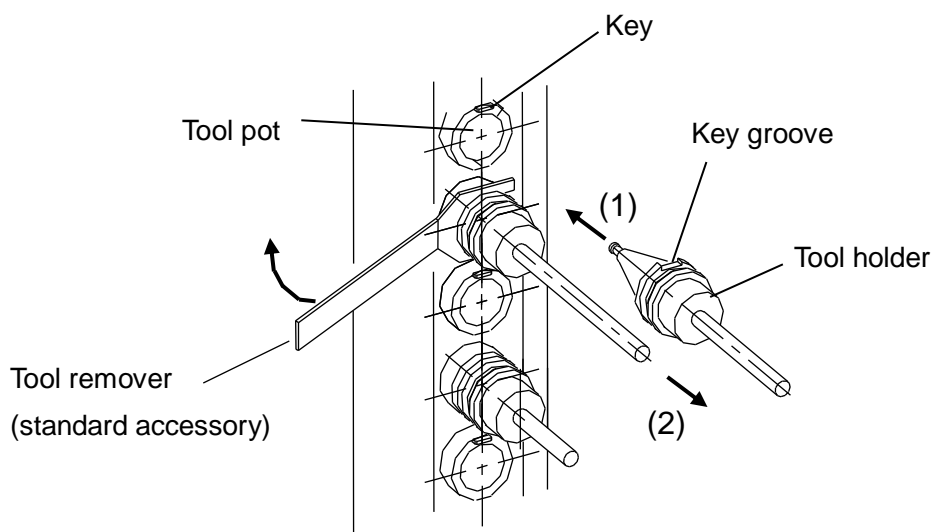
Open the ATC magazine door, and as shown in (1) below, insert a tool until it is caught in the pot. Key groove of Tool holder comes in contact with Key on Tool pot.

How to remove tools

As shown in (2) below, remove the tool using Tool remover.

Note 1: Distribute tools evenly in the magazine. Otherwise, unnecessary load will be exerted on the magazine chain, and this may cause trouble at tool change.

Note 2: Be sure to use Tool remover. Without this Tool remover, operator may be injured at hand.



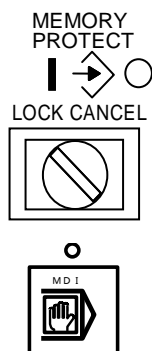
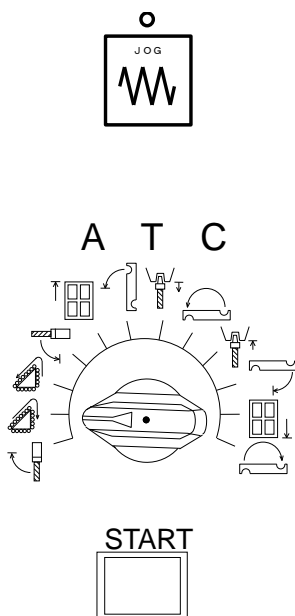
H. ATC OPERATION

H-2 Tool Registration

In this machine, two methods of tool registration are available; namely, using M101 and without using M101.

H-2-1 Tool Registration Using M101

When M101 is performed, tool numbers will become matched to their tool pot numbers. Performing M100 will clear all the tool numbers to “0.”



Procedure

1. Set all tools to be registered to the respective tool pots in the ATC magazine.
 - 1) Press JOG Mode pushbutton.
 - 2) Select Magazine rotation by ATC Manual Operation Switch (94), and press ATC Manual Start Pushbutton (95) to send the required tool pot to the setting area.
 - 3) Set Tool to the indexed tool pot.
 - 4) Repeat Steps 2) and 3) until all the required tools are set.

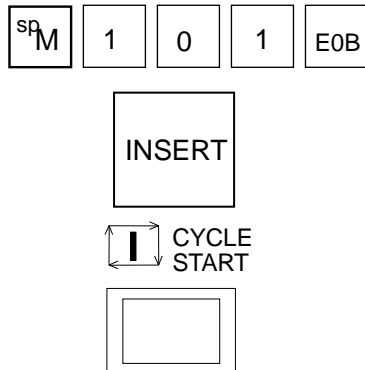
Note 1: Do not set a tool into the waiting pot.

Note 2: A tool can be set into the spindle only in Random Memory function. Otherwise, Alarm No. 1120 will occur at any T command after executing M101.

2. Set Memory Protect Release switch (67) on the main Operation panel to “CANCEL” and press MDI Mode pushbutton (4).

H. ATC OPERATION

3. Key in “M101; ” and press [INSERT], then press Cycle Start pushbutton (70). The tool numbers will be registered in such a way as they correspond to the respective tool pot numbers as below;



Tool Pot No.	Tool No.
1	1
2	2
:	:
40	40
Spindle	99(*)

* The spindle tool No. will vary depending on the magazine system.

4. Set Memory Protect Release switch (67) to LOCK.



Note 1: When M100 is commanded with Memory Protect Release switch (67) at CANCEL, all the tool numbers are cleared to 0.

Note 2: After execution of M101, tool numbers are assigned to all the tool pots regardless of whether tools are actually set or not.

H. ATC OPERATION

H-2-2 Tool Registration without Using M101

Tool Nos. can be registered one by one without using M101.

Procedure

1. Set tools to the magazine, and set Memory Protect Release switch to “CANCEL” as in Section H-2-1.
2. To display the DATA screen:
Press the following MDI key and Soft keys () at the bottom of the screen:

→ (>) → (>) → (PMC MAINT) → (DATA).

The Data screen will be displayed, and by pressing several times, the following table will be displayed.

NO.	ADDRESS	DATA	NO.	ADDRESS	DATA	NO.	ADDRESS	DATA
0	D5100	53	12	D5124	12	0024	D5148	24
1	D5102	1	13	D5126	13			
2	D5104	2						
11	D5122	11	23	D5146	23	0035	D5170	35

(“NO.” means Tool pot No. and “DATA” means Tool No.)

Pressing will display NO. 36 to NO. 71, and pressing again NO. 72 to NO. 107, and so on.

H. ATC OPERATION

3. Enter data in the following way:

Ex. To register the tool No. in Tool pot No. 14 as “1234,”

- 1) Set Memory Protect Release Switch at “CANCEL.”
- 2) Move the cursor (yellow) to NO. 0014 by [↓] or [↑] key.
- 3) Key in [1][2][3][4] and press [INPUT]. DATA will become “1234.”
- 4) Wait about ten seconds, and set Memory Protect Release Switch at “LOCK.”

Note 1: Numbers from “0000” to “9999” can be used for DATA. However, Tool No. 0000 means no tool.

Note 2: If the same Tool Nos. are entered, Feed Hold lamp (71) will flick and Error message No.2051 “TOOL NUMBERS COINCIDE” will be displayed *in about ten seconds*. In this situation however, next tool number can be registered. Keep an eye on Feed Hold lamp/LCD while entering Tool Nos.

H. ATC OPERATION

H-3 Fixed Tool Pot Function (FTP) for Large Tools

In case of the random memory system, the Fixed Tool Pot Function (FTP) is prepared for special purpose. Using this function (FTP), a tool can be returned to a fixed tool pot.

It is useful for big tools (Dia. 70 mm to 140 mm), for example.

M103 makes FTP function effective and M104 can release it.

The movement of FTP function is as below:

1. A big tool in FTP is called for ATC and the spindle clamps the big tool in the same way as the standard tool.
2. When a next tool is called for ATC, firstly without magazine rotation, the big tool in the spindle is exchanged with the tool in the ex-pot of the big tool. Here the big tool returns to the initial tool pot.
3. Then the magazine rotates.
The called tool and the temporary spindle tool are exchanged.

Note 1: The adjacent tool pots of a big tool are to be empty.

Note 2: When FTP is released by M104, the tool pot is controlled by random memory again.

Note 3: Even if FTP is released by M104, the adjacent pots of a big tool are still kept empty in memory. To use these tool pots again, tool number setting should be done.

H. ATC OPERATION

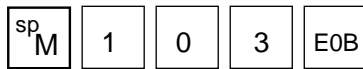
- (1) Setting of FTP by M103 [To be set for each tool number before using big tools.]

Procedure for setting

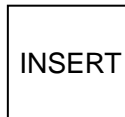
1. Set Memory Protect Release Switch (67) at "Cancel."



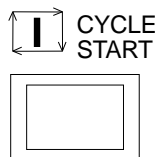
2. Input M103, T and tool number to be set for FTP in MDI mode.



M103 T ;
tool number



M103 T ;
.
.



3. Press Cycle Start pushbutton (70).

Note: One block of M103 can set one tool.

The tool pots next to the one set by M103 should be empty. At most, 20 big tools can be set in FTP function (in case of 40 tools ATC), with alternations of big tool and empty pot.

Tool number set for FTP by M103 shows minus " - " in front of the tool number on the LCD. The adjacent tool numbers are set "0" automatically.

- (2) Tool change of tool(s) in FTP

Call the FTP tool in the same way as the standard tool.

Note: ATC cycle time, using FTP function, will be longer than usual.

H. ATC OPERATION

(3) Release of FTP by M104

FTP function can be released by M104.

Procedure

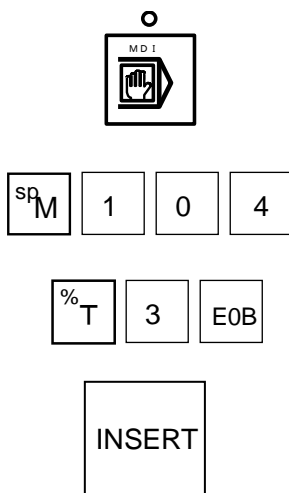
ex.) When releasing only T3 and T23 from FTP, the procedure is;

1. Set Memory Protect Release Switch (67) at "Cancel."

2. In MDI mode, input

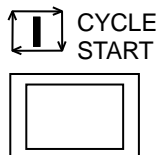
M104 T3 ;

M104 T23 ;



3. Press Cycle Start pushbutton (70).

Now, Tool No. 3 and No. 23 are set as standard tools and controlled by random memory.



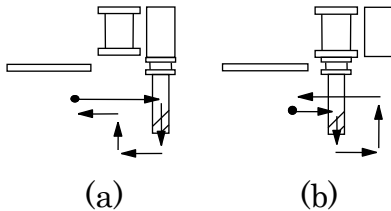
Note: When a tool is released from FTP, minus “ - ” goes off from the tool number on LCD.

The adjacent tool pots are kept empty in memory, showing “0”.

To use these empty tool pots, perform Tool Register.

H. ATC OPERATION

H-4 Single Arm Manual Operation (80/120ATC only)



Continuous Operation

1. Confirm Single Arm Manual Start Pushbutton (97) is lit on.
2. After setting Single Arm Manual Operation Switch (96) at (a) or (b), press Single Arm Manual Start Pushbutton (97). Tool will change places (a) from Waiting pot to Magazine pot or (b) from Magazine pot to Waiting pot.

Single Operation

Movements (c) to (i) of Section C-3 (96) of this manual are available only when JOG Mode is selected. Movements (c) to (i) are mainly used for maintenance.

If Single Arm is stopped by Emergency Stop Pushbutton during Single Arm Operation, follow the movements (c) to (i) to restore Single Arm.

Note 1: Remove the cause of the trouble before releasing Emergency Stop Pushbutton or alarm status.

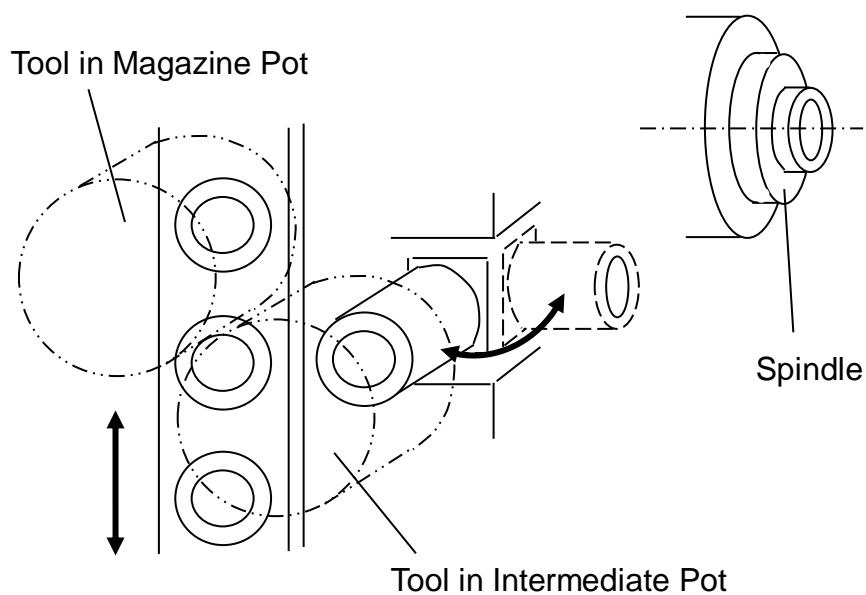
Note 2: In case that Single Arm is stopped between Magazine Pot and Waiting Pot by Emergency Stop Pushbutton, Single Arm slowly moves to Waiting Pot after Emergency Stop Pushbutton is released. Remove the cause of the trouble first, and set Single Arm Manual Operation Switch (96) at Single Arm movement in the required direction. Then release Emergency Stop Pushbutton and press Single Arm Manual Start Pushbutton (97).

H. ATC OPERATION

Notes on using large diameter tools (80/120ATC only)

When using large diameter tools ($\phi 95$ mm or more) on KH-45, tools in the intermediate pot and magazine pot can interfere with each other under the following conditions:

- 1) If you use two or more pcs of tools whose diameter is larger than 130 mm.
- 2) If you use at least one tool whose diameter is larger than 165 mm.



Therefore we have prepared a new option so that, if magazine rotation is commanded with a tool in the intermediate pot, the intermediate pot is automatically swung to the spindle side, then the magazine is rotated.

To use this option :

Please change the keep-relay No. K31.7 to "1". By this, there will be no interference of large tools.

Note 1: Do not set tools into the magazine pots adjacent to a large diameter tool.

H. ATC OPERATION

H-5 Tool Exchange in MDI Operation



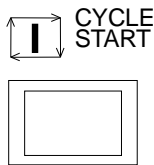
1. Press MDI Mode Pushbutton (4). Its lamp will be lit.
2. For Second Zero Point Return of X, Y and Z axes, press [PROG] key and input the following program.

```
G91 G30 Z0;
```

```
G91 G30 X0 Y0;
```

3. Input the tool number to be called.
In case of Tool number 10, input `T10;`.

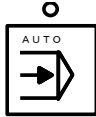
4. Input M code: `M6;` (tool weight: 0 to 5 kgs), or `M106;` (tool weight : 5 to 8 kgs).



5. The called tool and a spindle tool are exchanged by pressing Cycle Start Pushbutton (70).

H. ATC OPERATION

H-6 Tool Exchange in Automatic Operation



1. Press AUTO Mode Pushbutton (2). Its lamp will be lit.
2. The following is an example of a program containing tool exchanges.

Ex.

```
O1111;
```

```
N1 G90 G00 G54 X__Y__M__S__T__;
```

(machining program)

```
G91 G30 Z0;
```

```
G91 G30 X0 Y0;
```

```
M6;
```

```
N2 G90 G00 G54 X__Y__M__S__T__;
```

(machining program)

```
G91 G30 Z0;
```

```
G91 G30 X0 Y0;
```

```
M106;
```

Note 1: Command M106 to exchange heavy tools (5 kgs and over).

Note 2: If the specified tool is not in Magazine pots, Waiting pot or Spindle, Alarm No. 1125 occurs when M6 (M106) is commanded.

H. ATC OPERATION

For Fixed Tool Pot function only

How to Call an Empty Pot

Usually an empty pot can not be called to the spindle.

However, if it is necessary, please follow the steps below:

1. Set "PARAMETER WRITE" at "1: ENABLE" and change Keep Relay No. K53.0 to "1," then set "PARAMETER WRITE" at "0: DISABLE" (refer to Section U-1 of the Maintenance Manual).



2. In MDI mode, call an empty pot and execute a tool change command, e.g.

T10;

M6;

By this, Spindle tool (actually no tool) is regarded as Tool No. 10, and a tool set in Spindle becomes No. 10.

If you want to leave the tool in the machine, proceed to Step 4 below.

3. If you do not want to leave the tool in the machine, remove it and execute the following program in MDI mode.

T0;

M6;

G4 X1;

T0;

M6;

By this, Spindle tool as well as Waiting pot tool will become "0" (empty).

4. Set "PARAMETER WRITE" at "1: ENABLE" and change Keep Relay No. K53.0 to "0," then set "PARAMETER WRITE" at "0: DISABLE."

H. ATC OPERATION

Note: Make sure to bring the Keep Relay back to “0.” Otherwise, the machine will not check the presence of tools, and problems such as machining without tools may occur.

For Random Memory function only

How to Set a Special Tool to Spindle

Special tools such as test bars must be set to the spindle directly because they can not be contained in the magazine.

Procedure



1. In MDI mode, perform the following program:
(G91 G30 X0 Y0 Z0;)
T0;
M6;

The spindle tool will move to the waiting pot, and the spindle will become empty.

2. In JOG mode, set and clamp the special tool in the spindle by Spindle Tool Clamp/ Unclamp pushbutton (60).

Note: Do not perform ATC when a special tool is in the spindle.

3. When finished, remove the special tool from the spindle, and perform the following program:

Txxxx; (xxxx being the tool No. in the waiting pot)

M6;

The tool in the waiting pot will come back to the spindle.

Note: Make sure to return the tool in the waiting pot to the spindle. Otherwise, Alarm No. 1120 will occur at a call for another tool.

H. ATC OPERATION

H-7 Description of Screens

Tool numbers in Spindle, Waiting pot, etc. can be checked in the following way.

H-7-1 Display of Data Table Control Data Screen

Press the following MDI key and Soft keys () at the bottom of the display.

→ (>) → (>) → (PMC MAINT) → (DATA)

The following table will be displayed.

NO.	ADDRESS	PARAMETER	TYPE	NO. OF DATA
001	D0100	00000000	1	151
002	D0600	00000000	0	16
003	D1000	00000000	1	1
004	D0700	00000000	1	26

**Note: Usually above screen is not displayed because of protection.
Instead, you will go into the Data Table screen below at once.**

H. ATC OPERATION

H-7-2 Display of Data Table Screen

From above Data Table Control Data screen, press Soft key (ZOOM), and **PAGE** keys several times; the following table will be displayed (in case of 80ATC).

NO.	ADDRESS	DATA
0140	D0380	0
0141	D0382	0
0142	D0384	0
0143	D0386	53
0144	D0388	60 (Tool No. in Waiting Pot)
0145	D0390	80 (Total number of Magazine pots)
0146	D0392	0
0147	D0394	53 (T code No. read into NC)
0148	D0396	0 (Magazine Tool No. in ATC position)
0149	D0398	32 (Magazine Pot No. in ATC position)
0150	D0400	53 (Tool No. in Spindle)

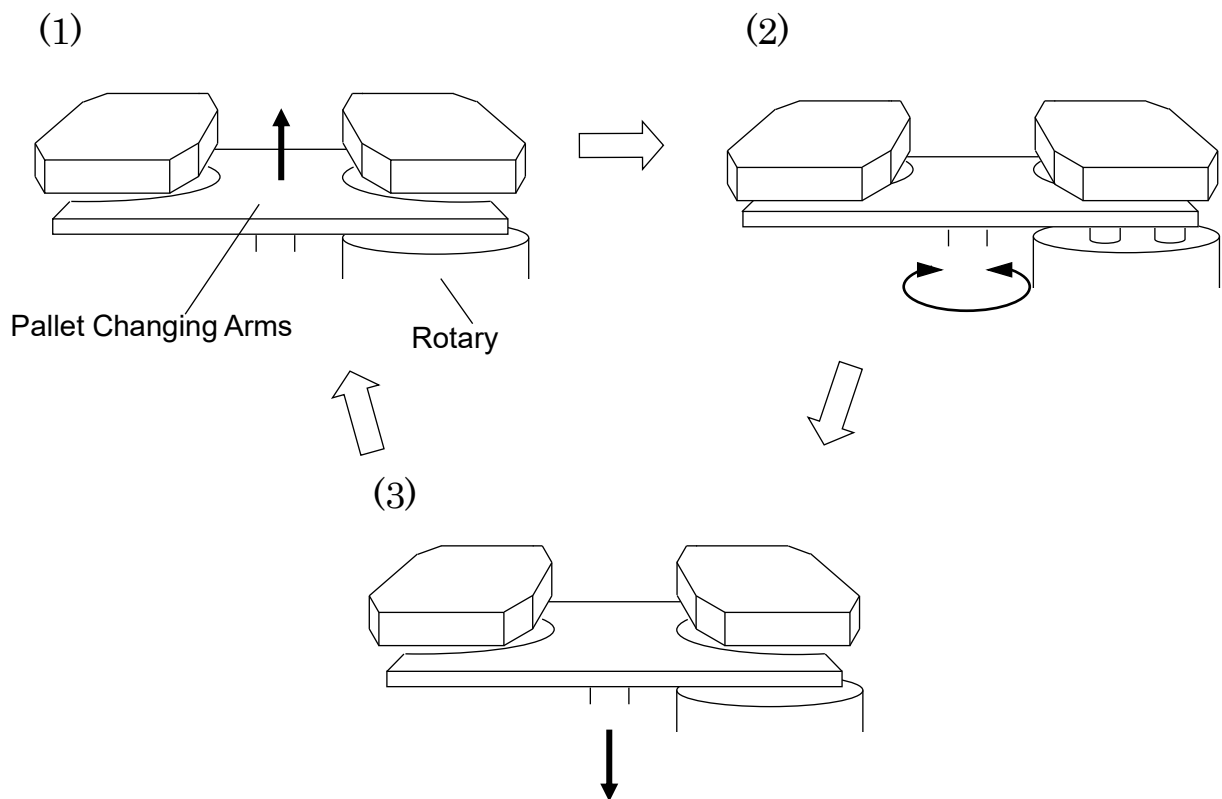
I. APC OPERATION

I. APC OPERATION

[This chapter is for 2-pallet machines only.]

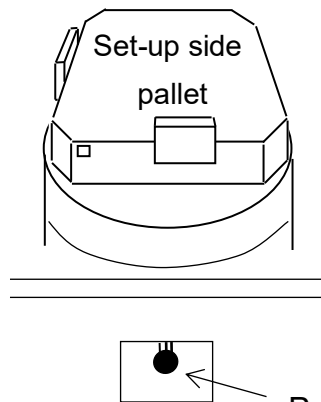
I-1 Movement of APC

1. The clamp pins (Mechanical lock) are unlocked on the rotary table (on the machining side), and the Pallet Changing Arms go up to raise the pallets.
2. Pallets turn 180 degrees to change position.
3. The Pallet Changing Arms go down and both pallets are seated.
4. The clamp pins of the rotary table lock the pallet onto the rotary table.



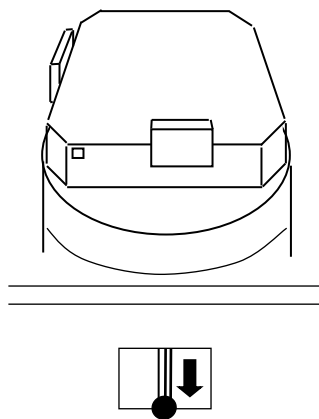
I. APC OPERATION

I-2 Pallet Indexing Lever



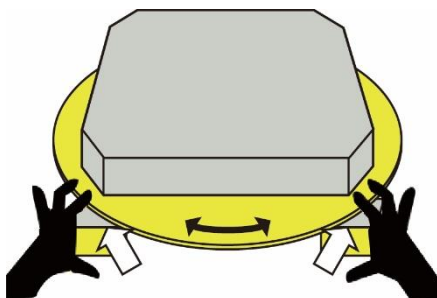
The pallet indexing lever positions and releases axial movement of a pallet in front.

When you turn the pallet:



Procedure

1. Press down the pallet indexing lever until it is locked at the bottom.
2. The pallet is free to turn.



When you turn the pallet (400 x 400 mm) by hand, keep your hands off the protection disk of the pallet. Otherwise your fingers may be caught between the disk and pallet changing arms.

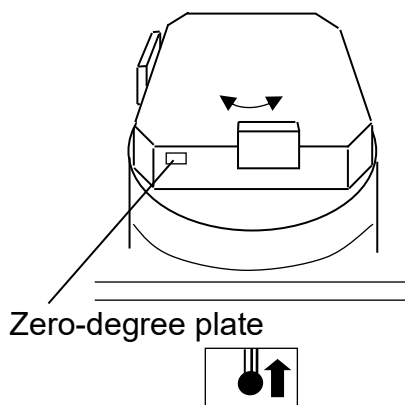
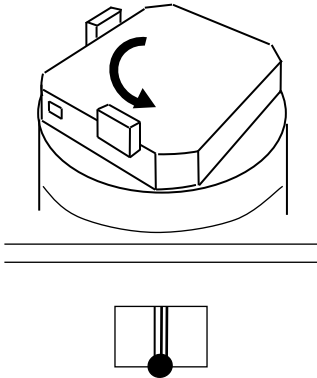
Moreover, do not apply force on the protection disk. If the protection disk is bent, it will collide with the pallet changing arms.

I. APC OPERATION

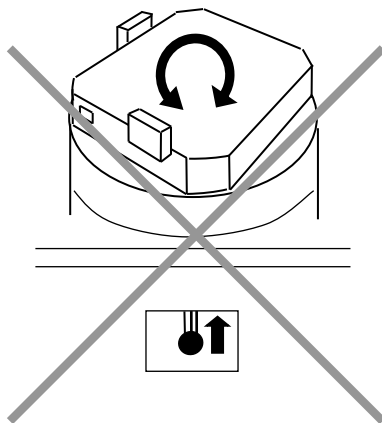
When you lock the pallet:

Procedure

1. Return the pallet approximately to its home position (the zero-degree plate comes in front).



2. Pull up the pallet indexing lever. AT this moment, the pallet lock pin inside may not go into place correctly. In this case, turn the pallet slowly by hand to find the exact position and lock it by the pallet indexing lever.

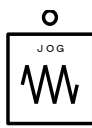


Note: Do not turn the pallet forcefully with the pallet indexing lever pulled up. The pallet lock pin would bang into place and get damaged.

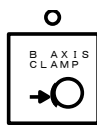
I. APC OPERATION

I-3 APC in Manual Operation

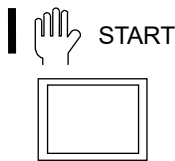
1. Perform the second zero point return (G91 G30 Z0 B0 M62;) on Z axis and B axis. When Z axis and B axis reach the second zero point, Zero Return Completion lamps (23) and (24) will blink.



2. Press JOG Mode pushbutton (6), and its lamp will be lit.



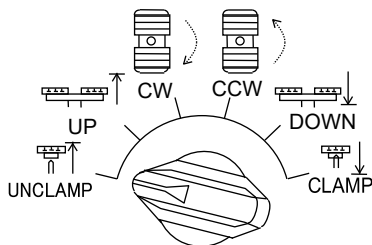
3. Make sure that the lamp of B axis Table Clamp pushbutton (47) is lit.



4. Be sure that the lamp of Pallet Start pushbutton (75) is lit on. (When this lamp is on, the pallet is in ready status.)

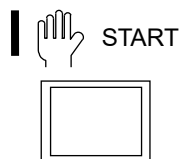
If the lamp is off, check the following points.

- Are all covers and doors closed?
- Is the ATC Double Arm in its home position?
- Is the pallet of loading side in the home position (the mark in front) ?
- Is the B axis clamped?



5. Set Pallet Manual Selection switch (74) at “UNCLAMP”, and press Pallet Start pushbutton (75).

The pallet on the machining side is unclamped.



I. APC OPERATION

6. Set Pallet Manual Selection switch (74) at “UP”, and press Pallet Start pushbutton (75).

The two pallets are raised.

7. Set Pallet Manual Selection switch (74) at “CW” or “CCW”, and keep pressing Pallet Start pushbutton (75) until the pallet changing arms finish a 180 degree turn.

8. Set Pallet Manual Selection switch (74) at “DOWN”, and press Pallet Start pushbutton (75).

The two pallets descend.

9. Set Pallet Manual Selection switch (74) at “CLAMP”, and press Pallet Start pushbutton (75).

The pallet on the machining side is clamped.

**Note 1: Pallet Position lamps (72), (73) show which pallet is on the machining side.
ex.) When LED No. 1 (72) is lit on,
Pallet No. 1 is on the machining
side and clamped.**

**Note 2: Before pressing Pallet Start
pushbutton (75), check the
interference between the
spindle/covers and the workpiece.
(Ref. Section K. INTERFERENCE of
this manual)**

**Note 3: To perform APC, all doors except for
the magazine door must be closed.**

I. APC OPERATION

I-4 APC in MDI Operation



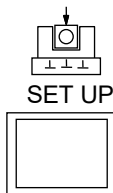
1. Press MDI Mode pushbutton (4), and the lamp is lit.
2. Perform the second zero point return on Z-axis and B axis so that the pallet moves to the APC home position.

G91 G30 Z0 B0 M62 ;

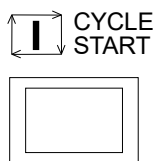
3. Input pallet No. to transfer to the machining side.

M71 ; Pallet No. 1 to the machining side.

M72 ; Pallet No. 2 to the machining side.



4. Press Pallet set-up pushbutton (76).



5. Press Cycle Start pushbutton (70).
The pallet changing arms turn so that the pallet commanded by M71 or M72 is moved to the machining side.

Note 1: Careful check on interference among the workpiece, covers and spindle is obliged before pressing Cycle Start pushbutton (70).

Note 2: All the doors except for the magazine door should be closed at APC.

I. APC OPERATION

I-5 APC in Automatic Operation



1. Press AUTO Mode pushbutton (2). The lamp lights up. (Machine goes into AUTO mode.)
2. Input programs on LCD.
 - i) Press [PROG] key.
 - ii) Press Address key [O].
 - iii) Input program number.
 - iv) Press cursor key [↓].

(Program example)

G91 G30 Z0 B0 M62 ; Z and B axes go
→ to the APC home position.

M71 ; Pallet No. 1 in the machining side.

G90 G00 G54 X_ Y_ M_ S_ T_ ;

→ Machining program of Pallet No. 1.

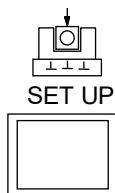
M1 ; Optional Stop.

G91 G30 Z0 B0 M62 ;

M72 ; Pallet No. 2 in the machining side.

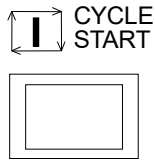
→ Machining program of Pallet No. 2.

M30 ; Program end.



3. When new workpieces are set, press Pallet set-up pushbutton (76).

I. APC OPERATION



4. Press Cycle start pushbutton (70).

Automatic operation is started, and the lamp of Cycle Start pushbutton is lit on.

In practice, programs using subprogram calls like below may be used.

Example of Program

O0001 (MAIN PROGRAM);

N10 (PALLET1);

M71;

M98 Pxxxx;

M01;

;

N20 (PALLET2);

M72;

M98 Pxxxx;

M01;

M99;

Move the pallet No.1 to the cutting side. If the pallet is not set up, the machine waits until the pallet No.1 is set up.

Move the pallet No.2 to the cutting side. If the pallet is not set up, the machine waits until the pallet No.2 is set up.

Call the machining programs as sub programs. "M99" must be placed at the end of the machining.

In case you want to repeat, place "M99" at the end of the program.

Pxxxx: xxxx is a machining program number.

Main program always starting with pallet change

The system variables #1001 and #1002 show which pallet is inside.

Referring to the system variables #1001 and #1002, you can always start from pallet change.

Values of #1001 and #1002.

Pallet inside	Value of #1001	Value of #1002
Pallet No. 1	1	0
Pallet No. 2	0	1

I. APC OPERATION

Example of Program

O0001 (MAIN PROGRAM);

N10 (PALLET1);

IF [#1001 EQ 1.] GOTO 20; ←

If the pallet No.1 is inside, the program execution jumps to "N20 (PALLET2);".

M71;

M98 Pxxxx;

M01;

;

N20 (PALLET2);

IF [#1002 EQ 1.] GOTO 10; ←

If the pallet No.2 is inside, the program execution jumps to "N10 (PALLET1);".

M72;

M98 Pxxxx;

M01;

M99;

By inserting the IF statement which checks #1001 or #1002 before M71 and M72, the machine always performs a pallet change, regardless of whether you start this main program from N10 or N20.

Note 1: Even when M71 or M72 is read into the NC, pallets are not changed without Pallet set-up pushbutton lamp (76) lit on.

Note 2: Press Pallet set-up pushbutton (76) only after making sure that workpieces are set on Pallet.

Note 3: When executing APC commands, make sure that the operation door and set-up doors are both closed.

J. EMERGENCY STOP

J. EMERGENCY STOP

J-1 Cases of Emergency

Emergency stop will take place in the following cases :

1. Hydraulic pump is overloaded (the thermal relay actuated).
2. Coolant pump is overloaded (the thermal relay actuated).
3. Emergency Stop pushbutton is pressed.
4. Spindle motor has some trouble.
5. The NC has some trouble.

When an emergency stop arises, the power supply to the NC will be cut off and LCD shows NOT READY status of NC.

Note: If an Emergency Stop pushbutton is pressed during memory editing in EDIT mode, the program being edited will be lost. Moreover, when the power is turned on again, the PS alarm 101 will be displayed on the screen; please refer to the alarm list of FANUC's Maintenance Manual.

J-2 To Release Emergency Stop Status

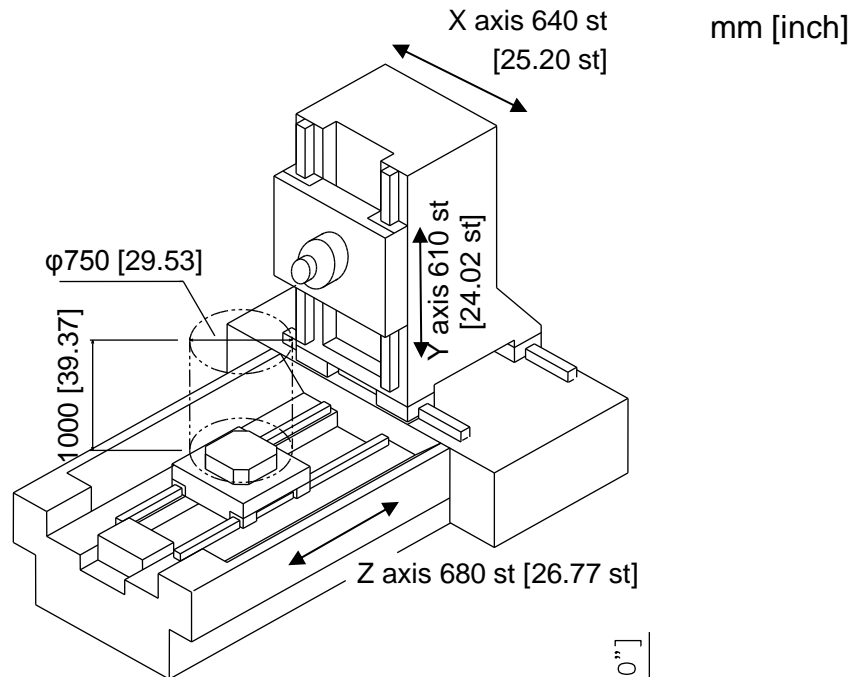
To release Emergency Stop status due to Cases 1 to 5 above :
Check the matter and remove the cause of the trouble. The trouble of NC unit, Spindle motor and Servo motors may accompany FANUC's alarms. In such a case, you may have to turn the main power off once. Please refer to D-2 of this manual.

K. INTERFERENCE

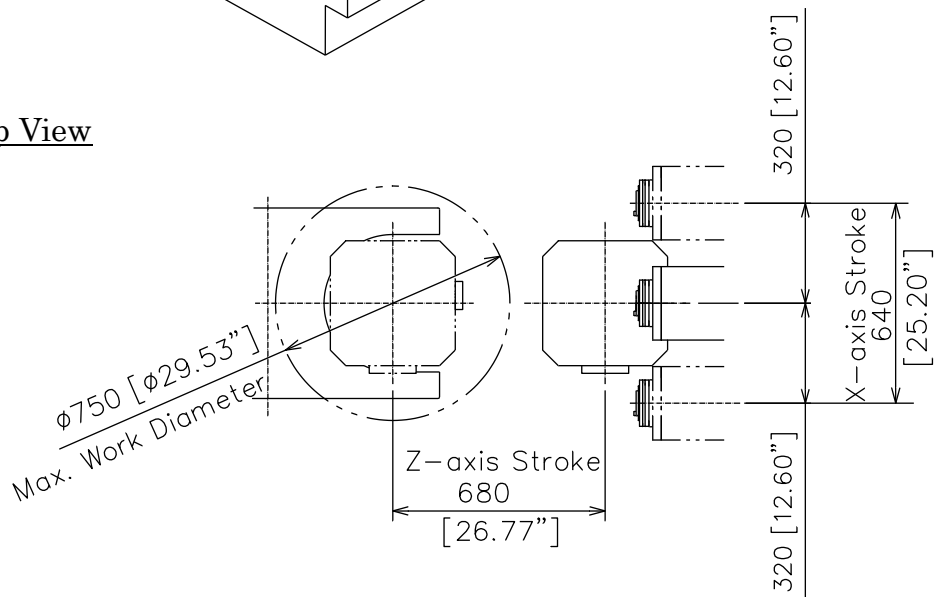
K. INTERFERENCE

K-1 Workpiece and Travels

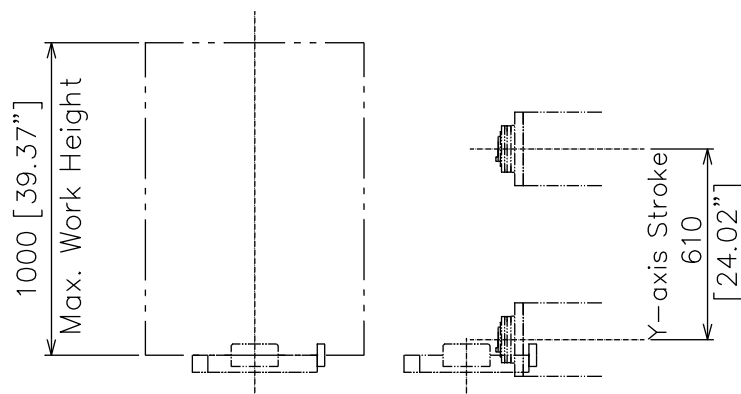
(Standard)



Top View



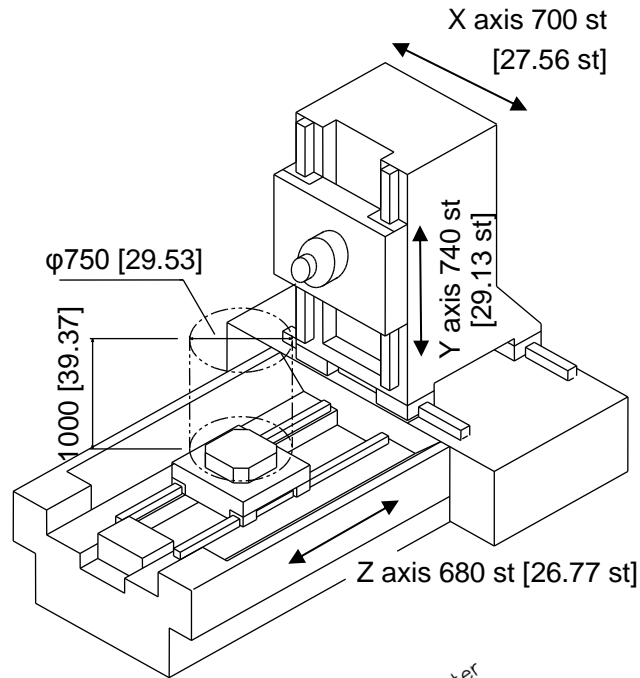
Side View



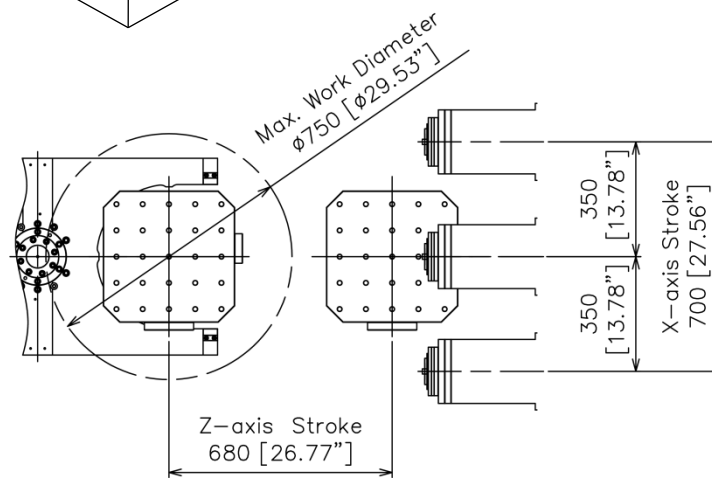
K. INTERFERENCE

(Axis Extension)

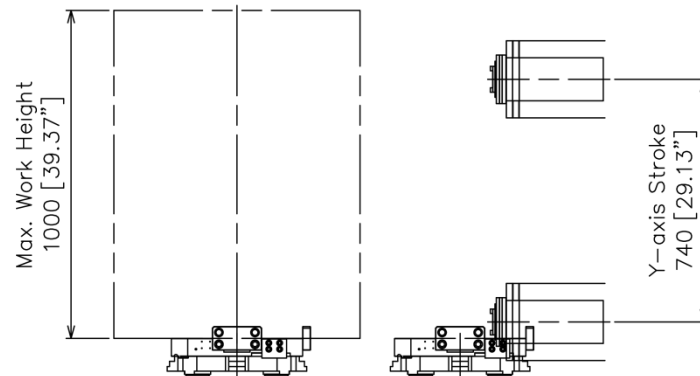
mm [inch]



Top View



Side View



K. INTERFERENCE

K-2 Spindle

Note: This is interferential area of the spindle and the pallet.

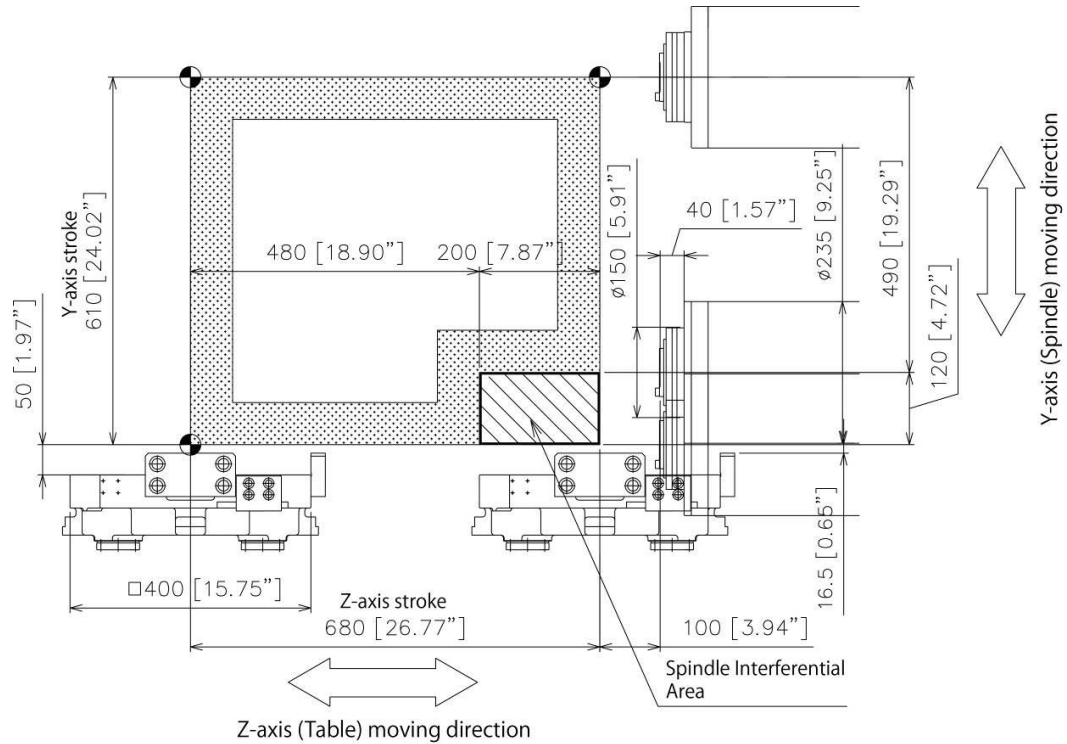
Be sure to avoid the spindle (Y-axis) and the pallet (Z-axis) together in this area marked with  .

If one of these axes is commanded to go into this area while the other is already in it, the machine will slow down, and then stop.

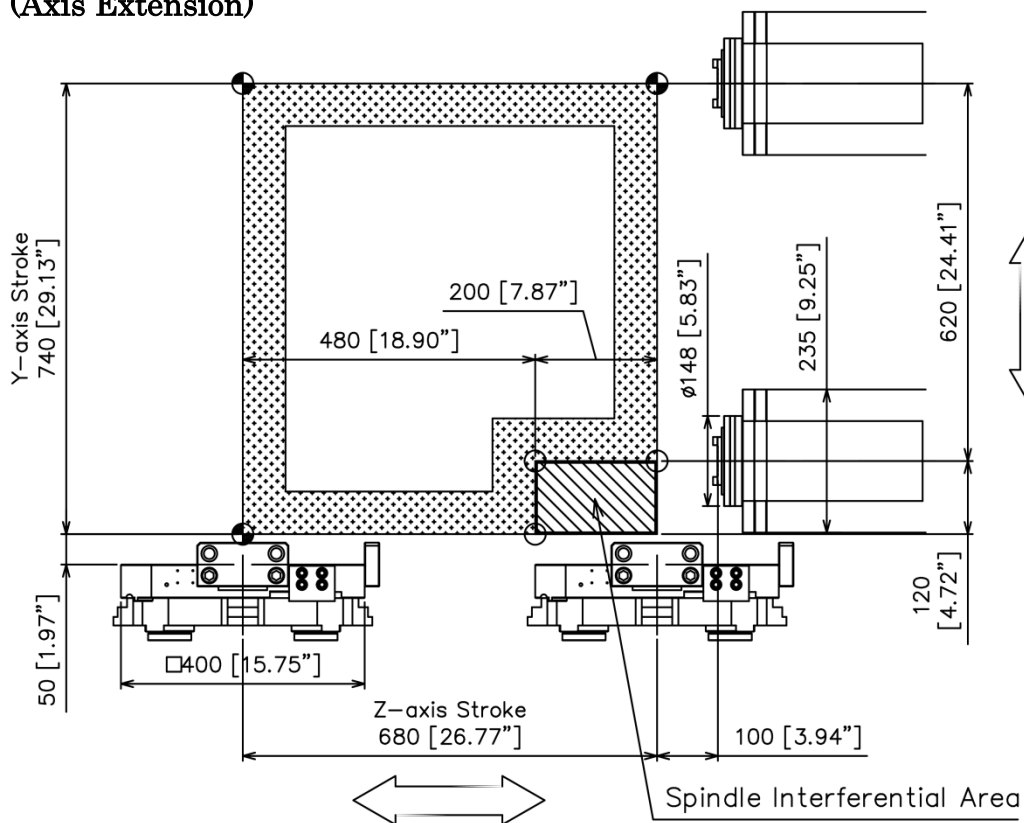
K. INTERFERENCE

For 400 mm Pallet Machines
(Standard)

mm [inch]



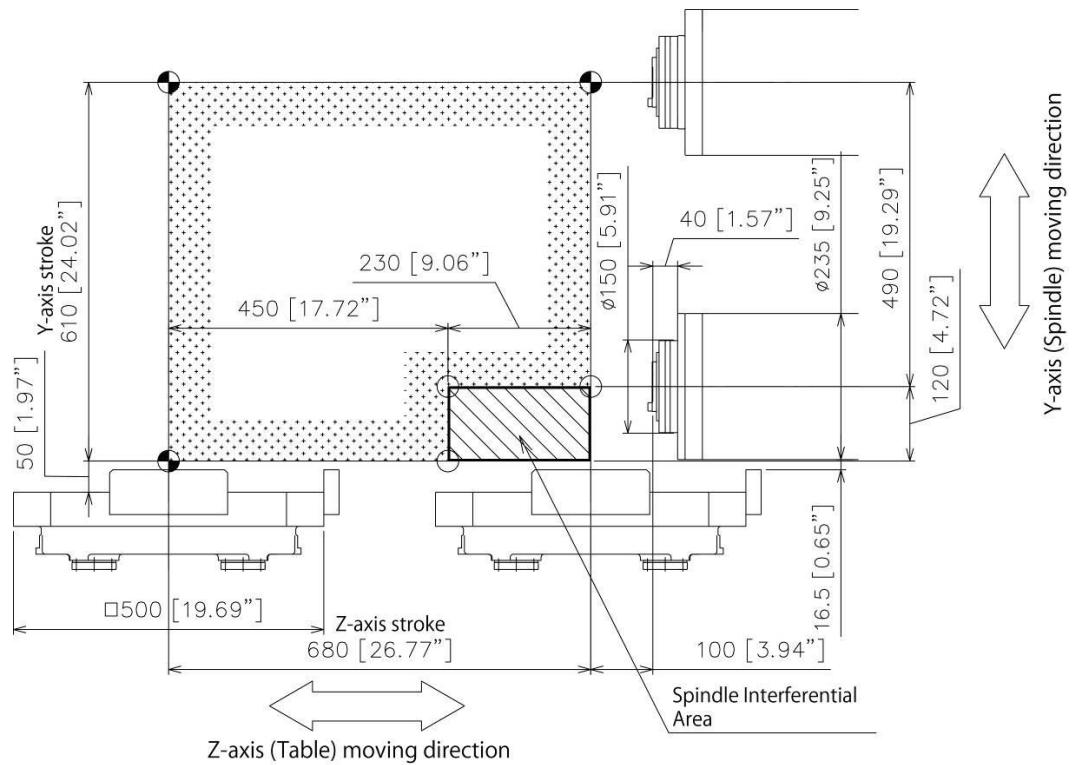
(Axis Extension)



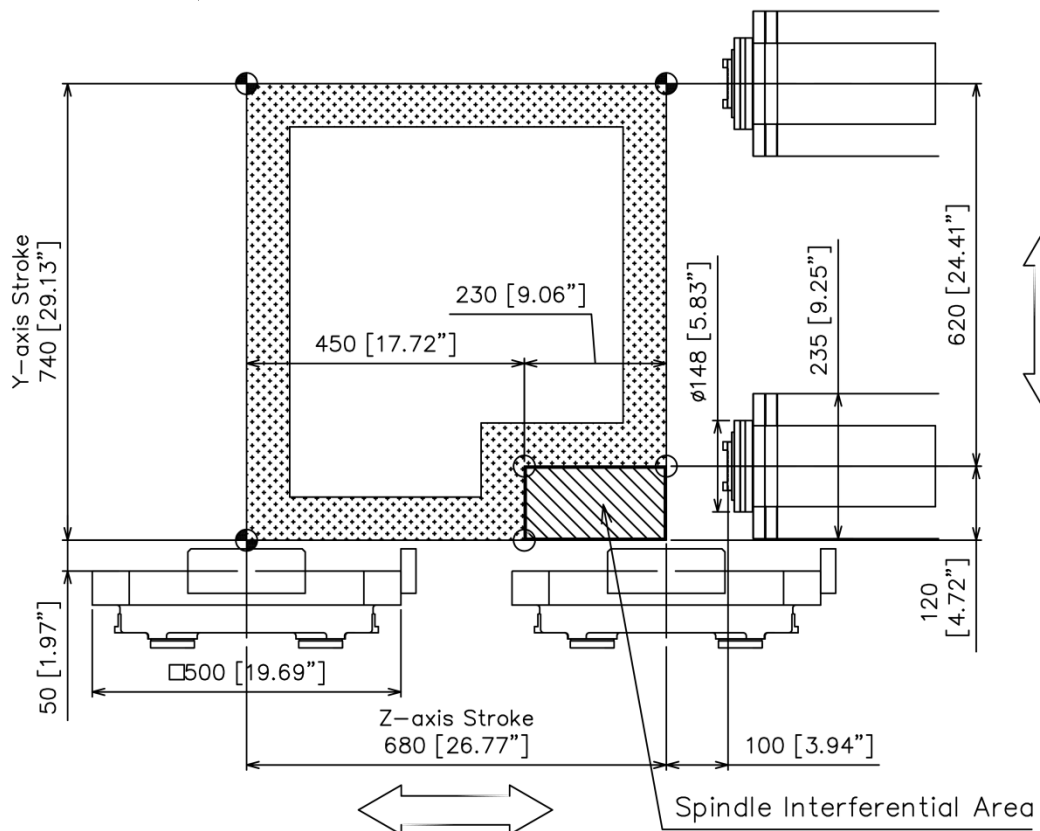
K. INTERFERENCE

For 500 mm Pallet Machines (Option)
(Standard)

mm [inch]



(Axis Extension)

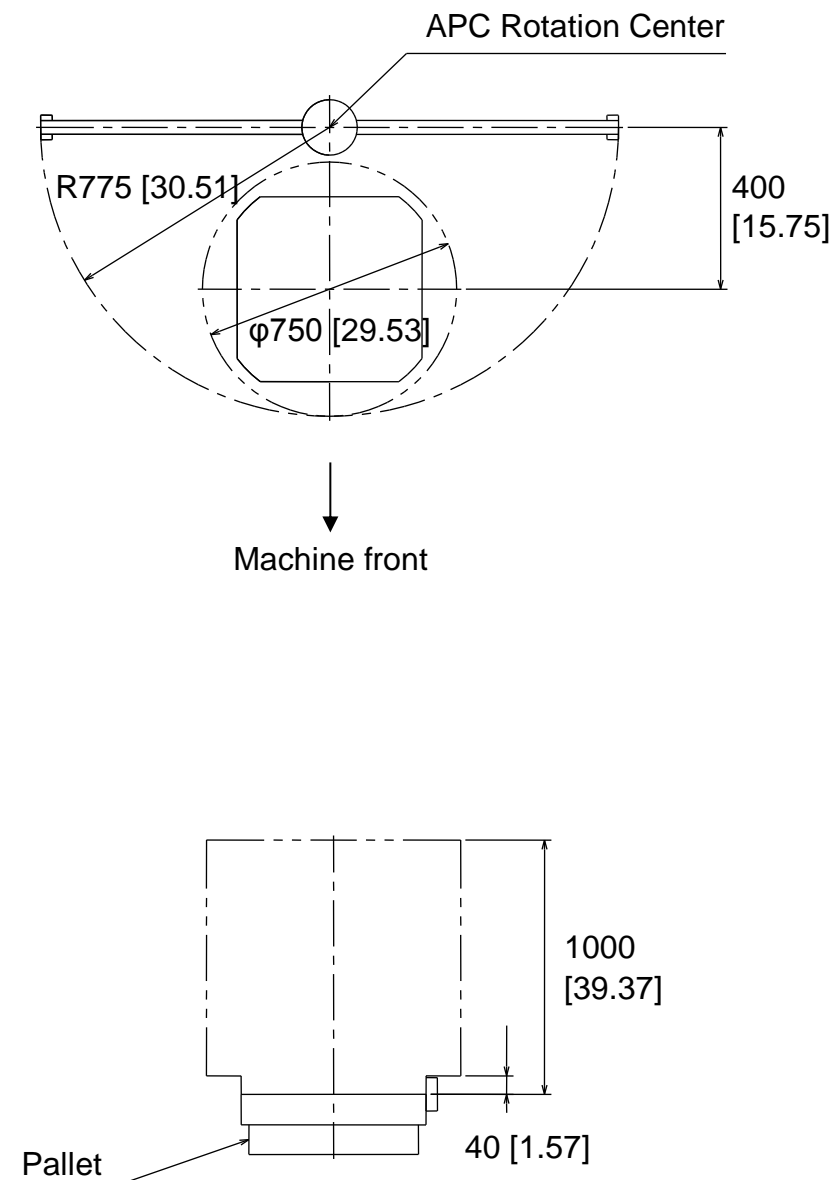


K. INTERFERENCE

K-3 Pallet Usable Max. Area

Max. Workpiece Height: 1000 mm

mm [inch]



K. INTERFERENCE

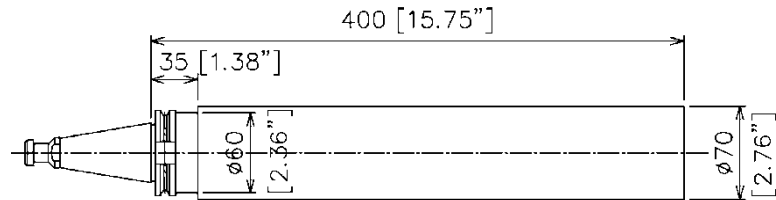
K-4 Tool

Max. Weight : 8 kg

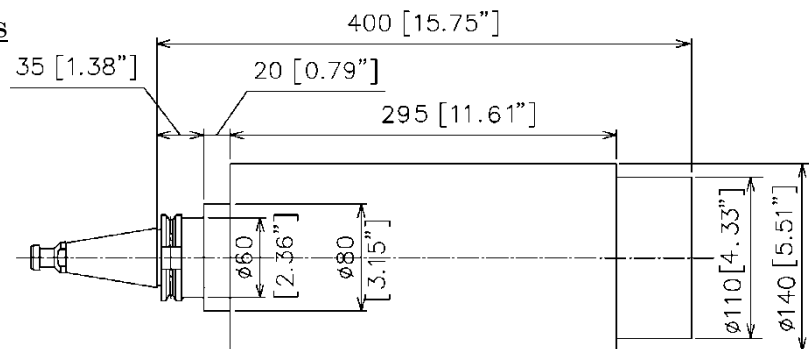
mm [inch]

(40/60ATC)

With adjacent tool(s)

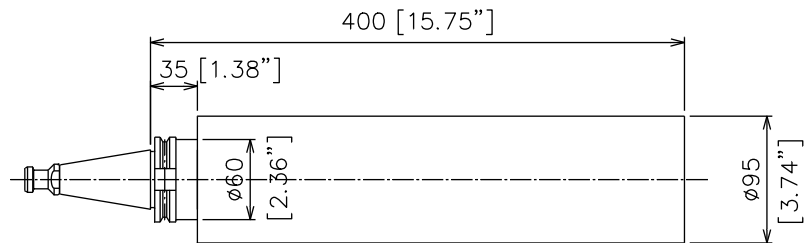


Without adjacent tools

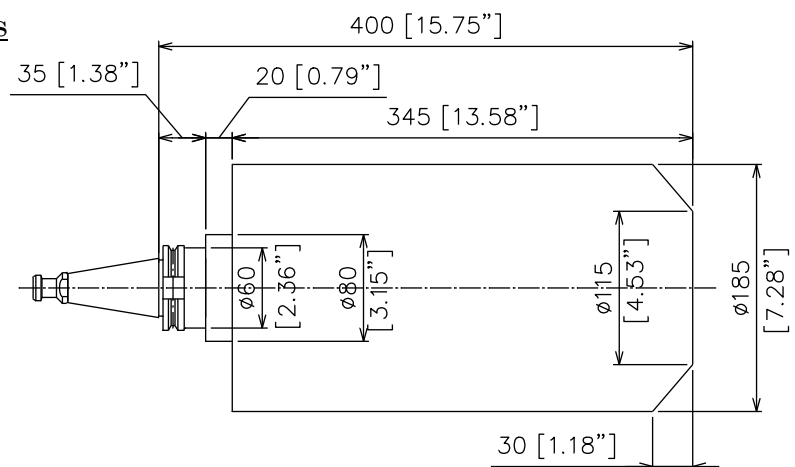


(80/120ATC)

With adjacent tool(s)



Without adjacent tools

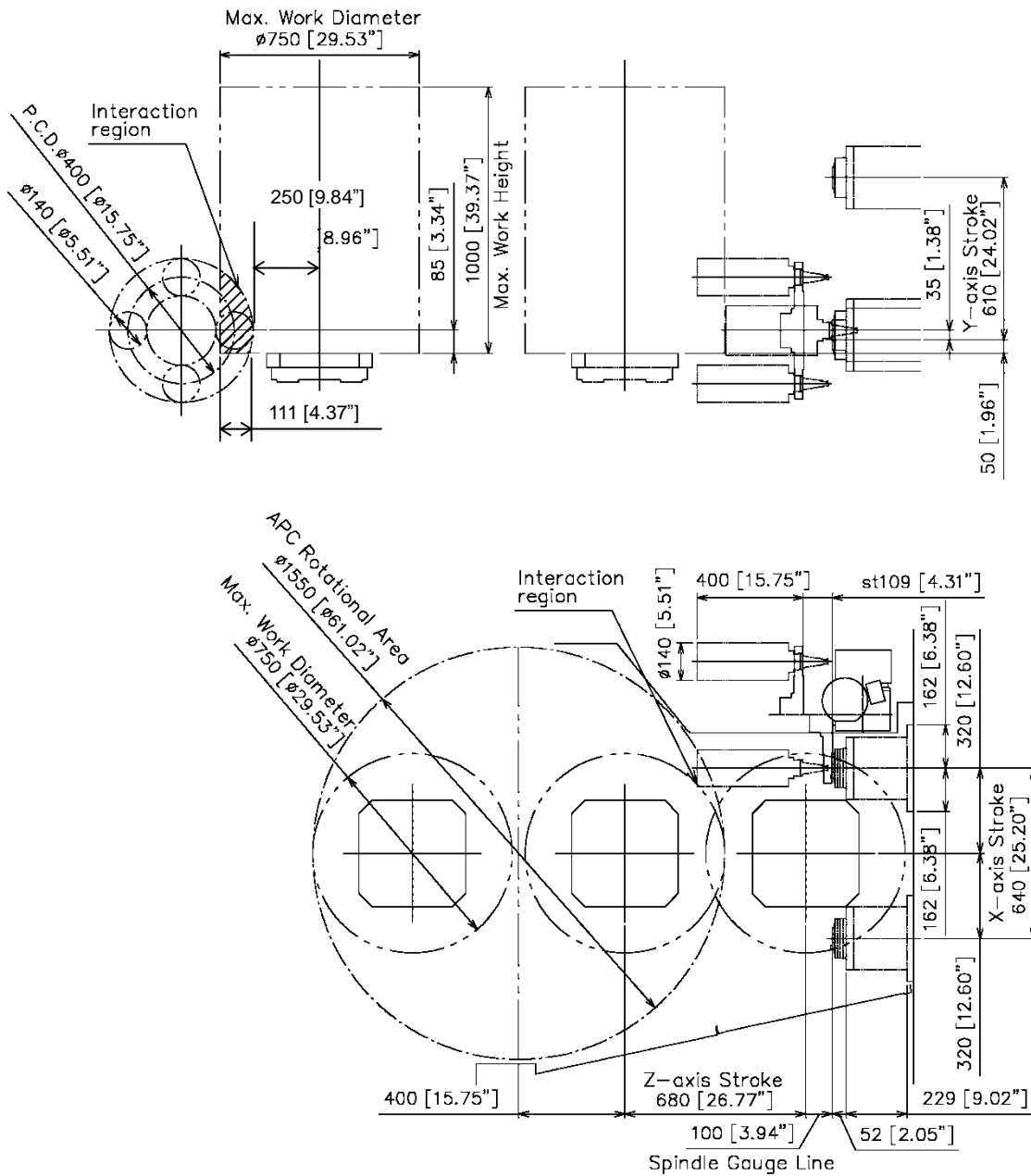


Note: Only physical interference is considered here.

K. INTERFERENCE

Interference at ATC (Standard 40/60ATC)

mm [inch]

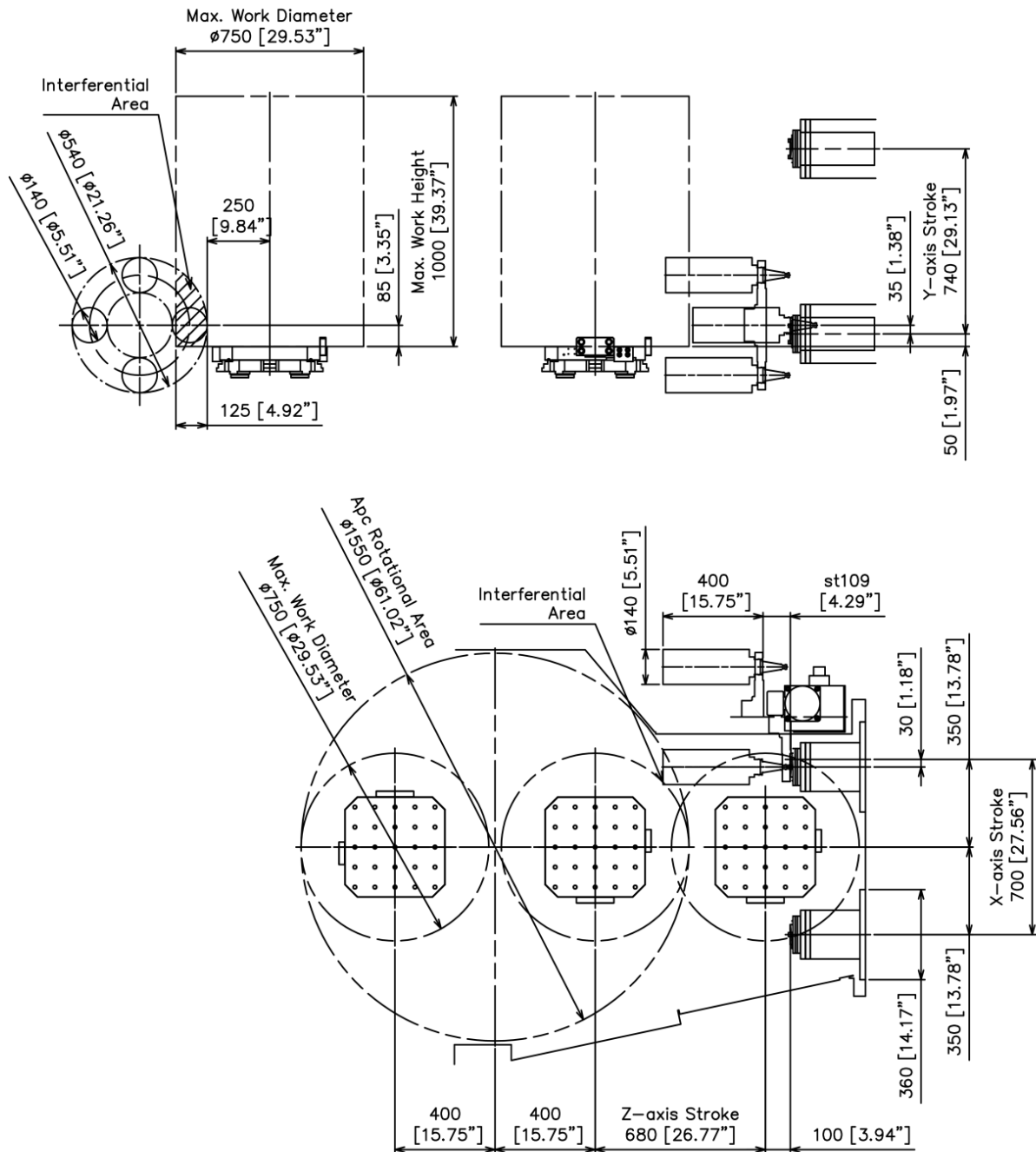


K. INTERFERENCE

Interference at ATC

(Axis Extension 40/60ATC)

mm [inch]

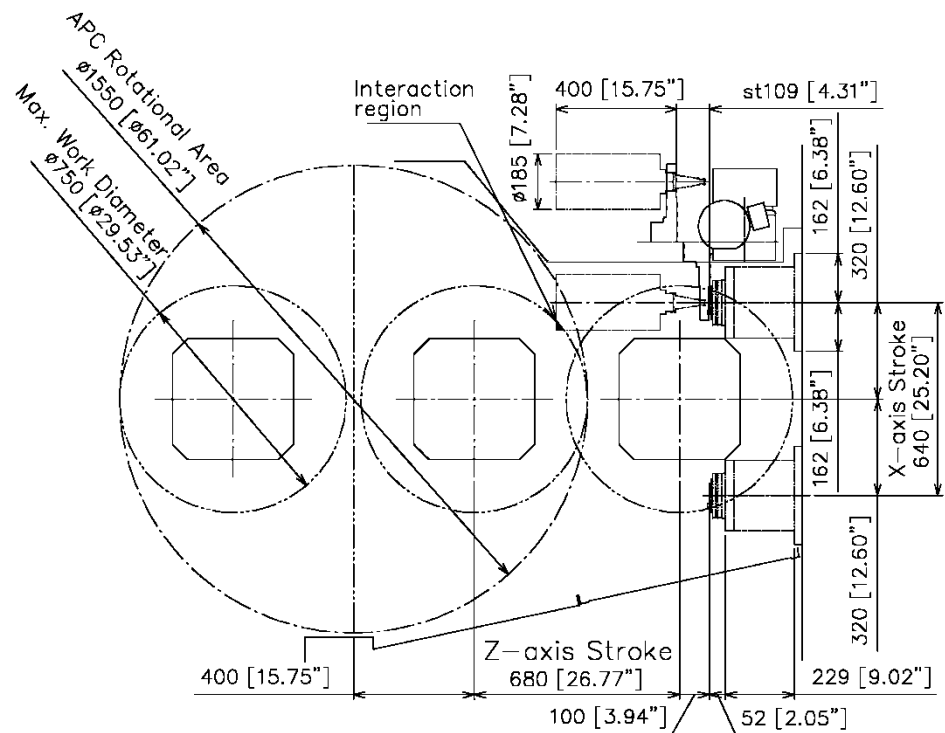
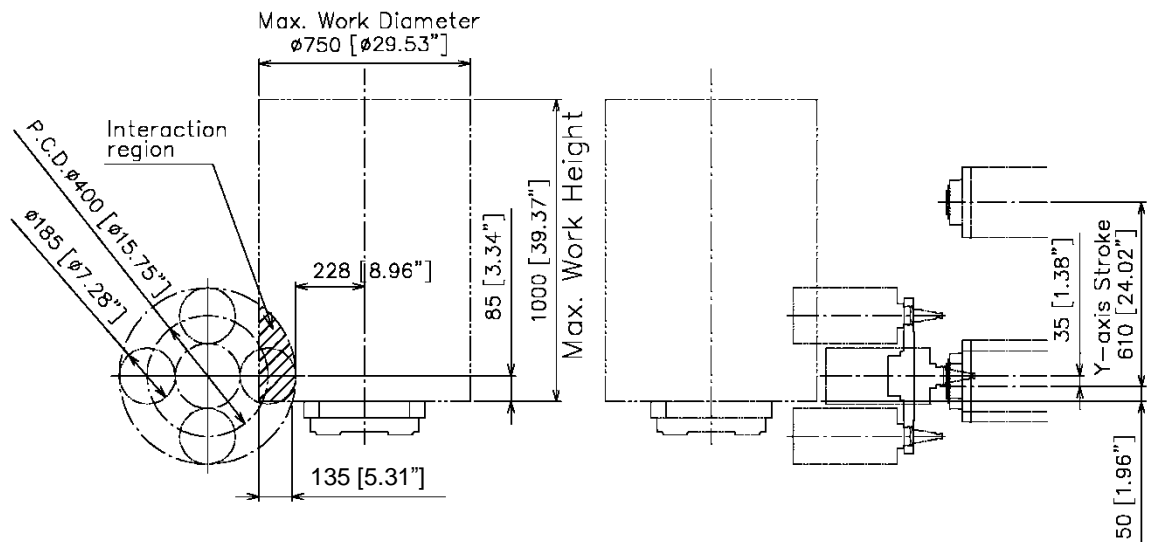


K. INTERFERENCE

Interference at ATC

(Standard 80/120ATC)

mm [inch]

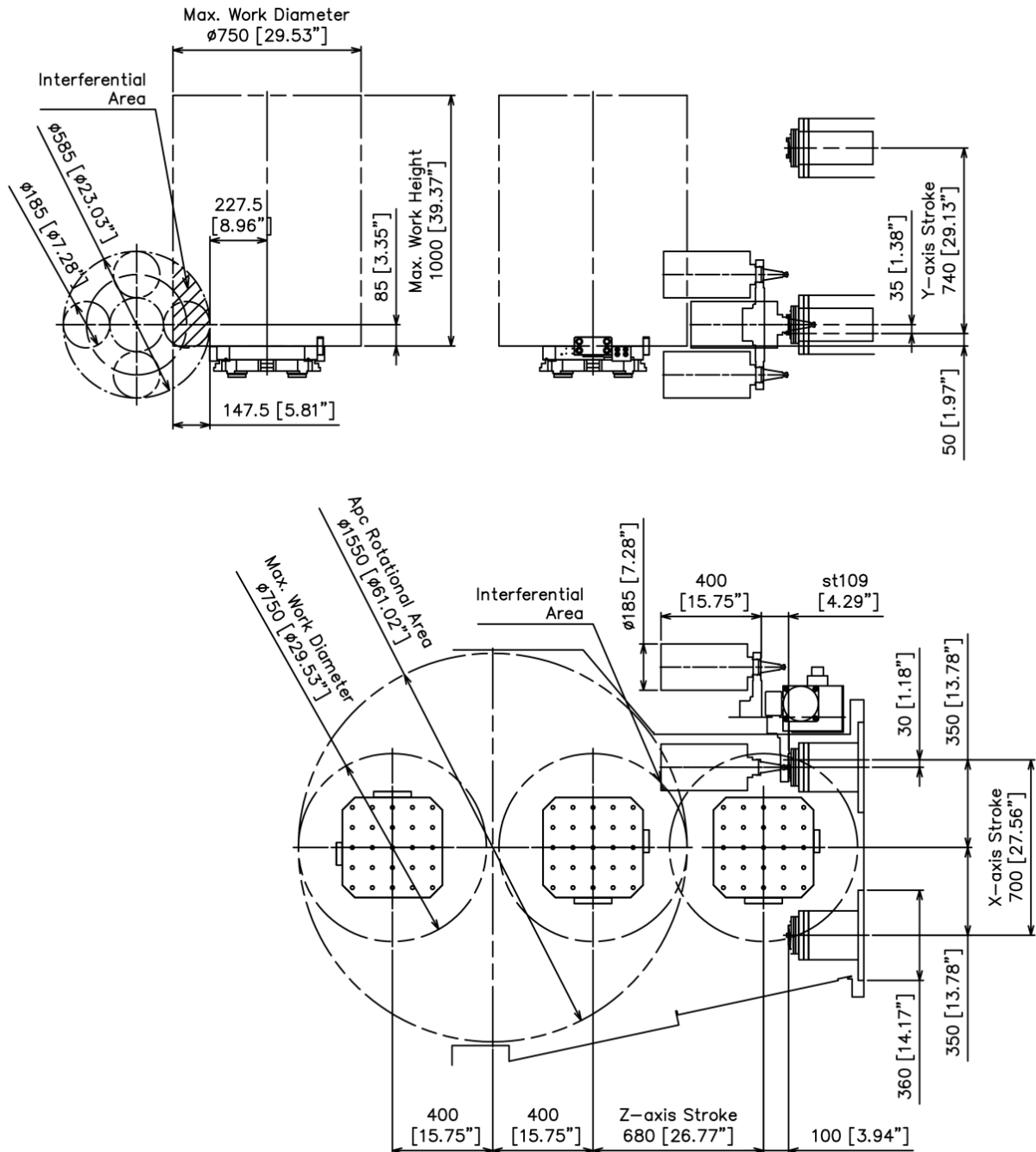


K. INTERFERENCE

Interference at ATC

(Axis Extension 80/120ATC)

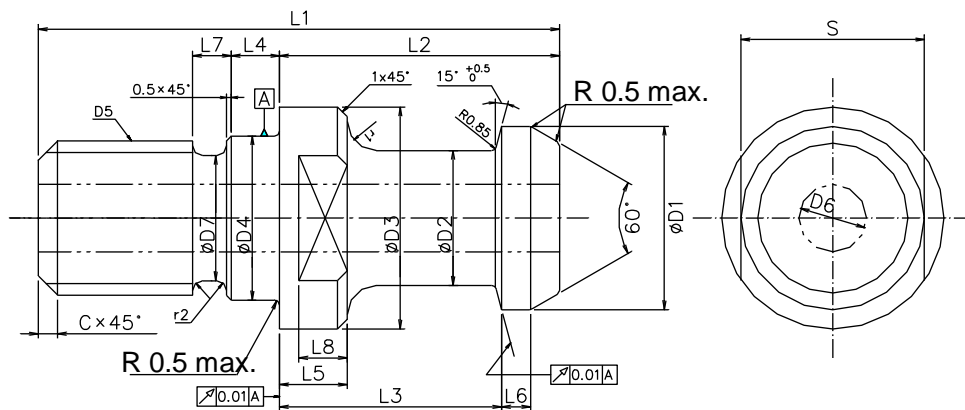
mm [inch]



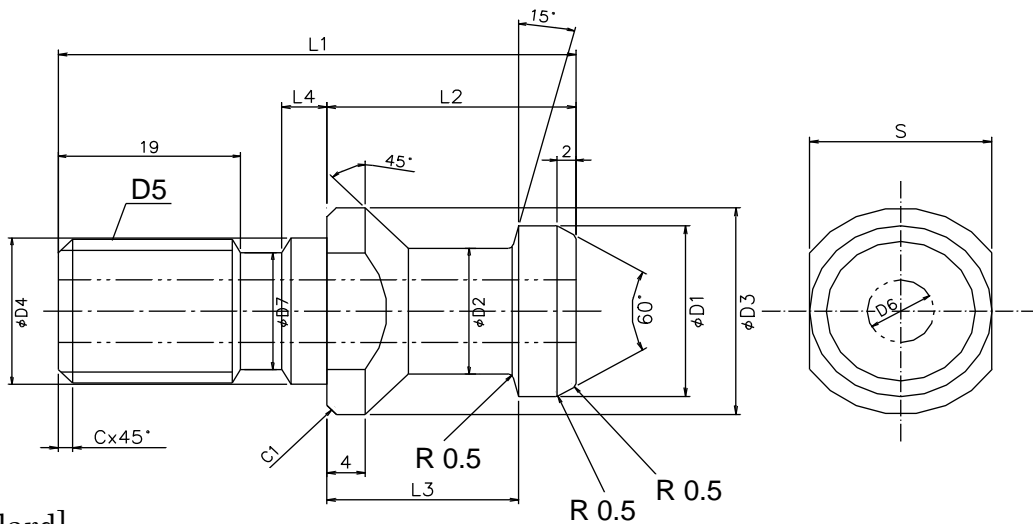
K. INTERFERENCE

K-5 Pullstud

BT40 (JIS40P)



CAT-40



[Standard]

BT 40		D1	D2	D3	D4	D5	D6	D7	L1	L2	L3
	mm	19	14	23	17	M16	7	13	54	29	23
	inch	0.748	0.551	0.906	0.670	×2	0.276	0.512	2.127	1.142	0.906
		L4	L5	L6	L7	L8	r1	r2	C	S	
	mm	5	7	3	4	5	3	1	1.5	19	
	inch	0.197	0.276	0.118	0.158	0.197	0.118	0.039	0.059	0.748	

CAT 40		D1	D2	D3	D4	D5	D6	D7	L1	L2	L3
	mm	19	14	23	16.28	5/8-11	7	13	54	26	20
	inch	0.748	0.551	0.906	0.640	UNC	0.276	0.512	2.127	1.024	0.787
		L4	L5	L6	L7	L8	r1	r2	C	S	
	mm	4.7							1.5	19	
	inch	0.185							0.059	0.748	

Note: The diameter of the through spindle coolant hole (D6) should be no more than 7 mm. Otherwise, coolant may leak.

L. MISCELLANEOUS FUNCTIONS (M CODE)

L. MISCELLANEOUS FUNCTIONS (M CODE)

L-1 M Function Code List

CODE	FUNCTION	
M00	Program stop (Spindle stop, 1st and 3rd coolant stop)	
M01	Optional stop (Spindle stop, 1st and 3rd coolant stop)	
M02	End of program (Spindle stop, 1st and 3rd coolant stop)	
M03	Spindle CW rotation start	
M04	Spindle CCW rotation start	
M05	Spindle rotation stop	
M06	Tool change	
M07	Cutting air blow start [Option]	
M08	1st coolant start	
M09	1st coolant and cutting air blow [Option] stop	
M11	3rd coolant start (through spindle coolant system) [Option]	
M12	3rd coolant stop (through spindle coolant system) [Option]	
M15	4th coolant start (bed flushing)	
M16	4th coolant stop (bed flushing)	
M19	Spindle orientation	
M29	Rigid tap	
M30	End of program (program rewind, spindle stop, 1 st /3 rd coolant stop)	
M38	Lubrication pump turned on	
M48	Feed rate override valid	
M49	Feed rate override invalid	
M58	Automatic door open [Option]	
M59	Automatic door close [Option]	
M61	B axis clamped	Ref. F-5
M62	B axis unclamped (for one movement only)	
M63	B axis unclamped (continuous)	
M68	Tool breakage/measurement detector up [Option]	
M69	Tool breakage/measurement detector down [Option]	
M71	Pallet No. 1 transferred to machining area	
M72	Pallet No. 2 transferred to machining area	
M75	Spindle probe mode [Option]	
M76	Automatic tool measurement mode [Option]	
M78	Spindle override valid	
M79	Spindle override invalid	
M83	Hydraulic unit warm-up (5 min.)	
M84	Hydraulic unit warm-up (10 min.)	
M86	Chip conveyor started [Option]	
M87	Chip conveyor stopped [Option]	
M98	Sub-program call	
M99	End of sub-program and program repeat	

L. MISCELLANEOUS FUNCTIONS (M CODE)

CODE	FUNCTION	
M100	Tool numbers all cleared	
M101	Tool numbers set in order	
M103	Pot set for big tool	
M104	Big tool pot canceled	
M106	Heavy tool ATC (Tool weight : 5kgs or more)	
M117	Tool magazine rotation prohibited	
M118	Tool magazine rotational speed slow down (50%)	
M119	Tool magazine rotation possible/Speed full (100%)	
M161	Tool chucking	* Maintenance use only
M162	Spindle tool unclamped	
M164	Double arm 180° forward rotation	
M165	Double arm 180° backward rotation	
M166	Spindle tool clamped	
M167	Double arm returned to home position	
M168	Tool pot turned to Magazine side	
M169	Tool pot turned to Double arm side	
M171	ATC shutter opened	
M172	ATC shutter closed	
M191	Spindle external orientation 1 (Setting data device : D900)	
M192	Spindle external orientation 2 (Setting data device : D902)	
M193	Spindle external orientation 3 (Setting data device : D904)	
M194	Spindle external orientation 4 (Setting data device : D906)	
M199	Test of all the lamps on the operation panel	
M200	Automatic tool length measurement mode [Option]	
M201	Automatic tool breakage detection mode [Option]	
M206	Heavy tool ATC (Tool weight : 5kg or more)	
M221	[Renishaw] End surface measurement mode [Option]	
M222	[Renishaw] Centering mode [Option]	
M223	[Renishaw] Calibration mode [Option]	
M250	Parameter setting for AICC cancelled	
M251	Parameter setting for AICC; Priority in precision over speed	
M252	Parameter setting for AICC; Medium setting	
M253	Parameter setting for AICC; Priority in speed over precision	

L. MISCELLANEOUS FUNCTIONS (M CODE)

Note 1: M00, M01, M02, M30, M98 and M99

These commands are executed only after axis moving commands. Contrarily, the other M commands are executed at the same time as axis moving commands.

Note 2: M00

Operation stops after executing the block containing M00. As well as in the case of Single block, modal data is kept stored.

Note 3: M01

Only when Optional Stop pushbutton (10) on the operation panel is ON, operation stops after executing the block containing this code.

Note 4: M02, M30

These codes mean the end of the main program.

The machine falls in the status of reset, and the program is rewound to the top.

Note 5: M06

When these codes are read with the spindle in a wrong position for ATC, alarm message "ATC ALARM" is displayed on the LCD, and the lamp of Feed Hold pushbutton (71) blinks.

Press [RESET] key on the NC keyboard, and move the spindle to the ATC position in MDI mode (Ref. H-4).

Note 6: M06

Use this code when both the tool in spindle and the next tool are under 5kgs.

Note 7: M106, M206

Use this code when either one of the two tools (spindle tool/ next tool) is over 5kgs.

Note 8: M19

Be sure to command M19 after stopping the spindle by M05.

M. ALARM MESSAGE

M. ALARM MESSAGE

Please refer to the attached “Trouble Shooting”.

(English only)

APPENDIX I MACRO PROGRAM

APPENDIX I

MACRO PROGRAM

1. CUSTOM Macro

For Custom Macro, some of the following programs have been installed in the machine at factory.

	Program No.	Application	Parameter		Remarks
			No.	Value	
1	O9001	ATC (light tools): M6	6071	6	
2	O9002	ATC (heavy tools): M106	6072	106	
3	O9003	APC (Pallet No.1 transferred to the machining area): M71	6073	71	For 2-pallet machines only
4	O9004	APC (Pallet No.2 transferred to the machining area): M72	6074	72	For 2-pallet machines only
5	O9020	Automatic tool length measurement: M200	6080	200	Option
6	O9021	Automatic tool breakage detection: M201	6081	201	Option
7	O9023	Automatic Zero return of the B axis for APC (subprogram call)			Used in O9003 and O9004
8	O9029	APC and program number search (subprogram call)			For 6-pallet machines only

Note 1: For example, a series of ATC steps will be automatically performed just by commanding M06, regardless of the location of the spindle or table.

Note 2: Do not make any changes to these programs.

APPENDIX III (PROGRAMMING)

APPENDIX III

PROGRAMMING

1. M Codes for Orientation at Arbitrary Angles (M191 to M194)

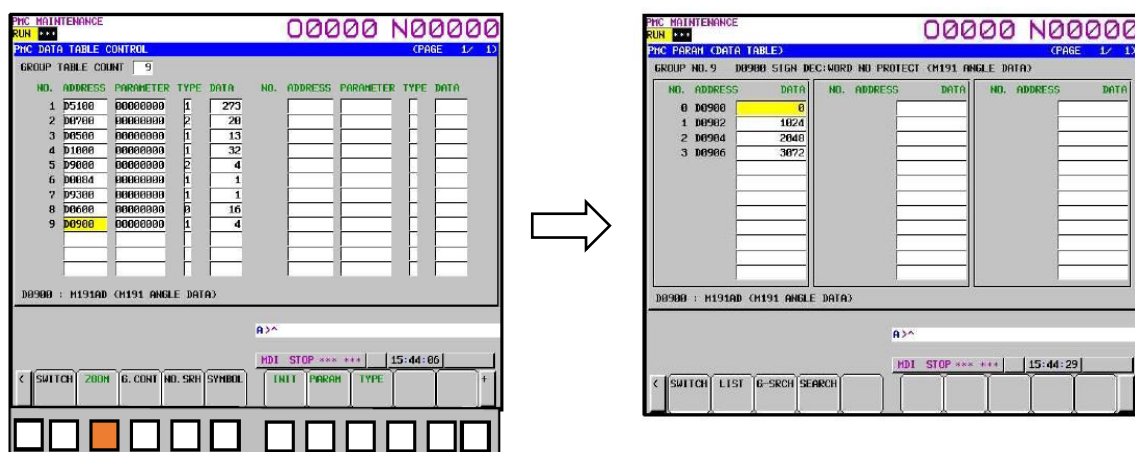
M191-194 are four additional orientation M codes for fixing the spindle at any angle.

By setting the angle data in PMC group data and using M191-194, you can orient the tool such as angle heads in any direction.

For example:



Set angle data on the following “PMC DATA TABLE CONTROL” screen. To show this screen, please push keys in order of “SYSTEM”, Right soft key, “PMC MAINTEN”, Right soft key, and “DATA”. (In case of 10.4” screen.)



On “PMC DATA TABLE CONTROL” screen, select “D900” for example, then press “ZOOM” soft key.

APPENDIX III (PROGRAMMING)

Here, the data apply to the M codes as below:

D0900 (D1040 for KH-55): Angle data for M191

D0902 (D1042 for KH-55): Angle data for M192

D0904 (D1044 for KH-55): Angle data for M193

D0906 (D1046 for KH-55): Angle data for M194

Setting Values

The setting values differ depending on the machine models as below.

Offset Angle (deg.)	Machine Model	
	KH-4100, KH-4100kai(*), KH-4500, KH-55	KH-4100kai(**), KH-4500kai, Triple H40
90	1024	90
180	2048	180
270	3072	270
360	4096	0

(*): Machines with S/N JSK6001 to JSK6004

(**): Machines with S/N JSK6005 and later

For KH-4100, KH-4100kai(*), KH-4500, and KH-55, use the following formula to calculate the data to be set:

Angle Data = “Offset angle you want to use (in degrees)” / 360° × 4096

Note 1: You can't set minus values.

Note 2: The offset angles are amounts from M19 position. The M19 position may not exactly be parallel to the Y axis. Therefore, the position of M191-194 may need some correction.

APPENDIX III (PROGRAMMING)

2. AICC Mode Setting by M Codes (M250 to M253)

For KH-41/4100/4100kai and KH-45/4500/4500kai only

For machines with AICC, we have prepared M codes for setting of three cutting modes according to customers' preference of precision and speed in machining.

By commanding an M code, the desired values are automatically set for the related parameters (acceleration rates, etc.).

Explanation of M Codes (for AICC I and II)

1) Three settings are prepared as below:

M Codes	Precision	Speed	Aimed Tolerance in Right Angled Corner
M251	***	*	0.01 mm
M252	**	**	0.02 mm
M253	*	***	0.04 mm

***: Good, **: Average, *: No priority

Note: Above values of Aimed Tolerance are based on the typical data we achieved while testing without any loads. We do not guarantee them.

2) M250 is prepared to cancel the above M codes.

How to Use

Please place M code in the previous block of "G5.1 Q1." if you want to change the mode. And if you want to cancel it, please place M250 in the next block of "G5.1 Q0."

(Sample program)

O1

G91G94

N1S3000M3

M251

*Put M251 to M253 in the block before G5.1Q1.

N2G05.1Q1

APPENDIX III (PROGRAMMING)

G01X20.000F5000.000
G01Y-20.000F5000.000
G01X-20.000F5000.000
G01Y20.000F5000.000

:

G05.1Q0

M250 *Be sure to put M250 in the block after G5.1Q0.

G04X1.M5

N999G04X1.

M99

Note 1: While M251 is commanded, “AI M251” will be indicated blinking at the right bottom of the NC screen.

Note 2: The substance of these M codes are macro programs. Please don't push “RESET” or “EMERGENCY STOP” button while executing these M codes.

Note 3: We do not recommend to change the mode while AICC mode is on.

Note 4: The AICC level canceled by M250 is same as that executed by M252 (default setting at shipment).

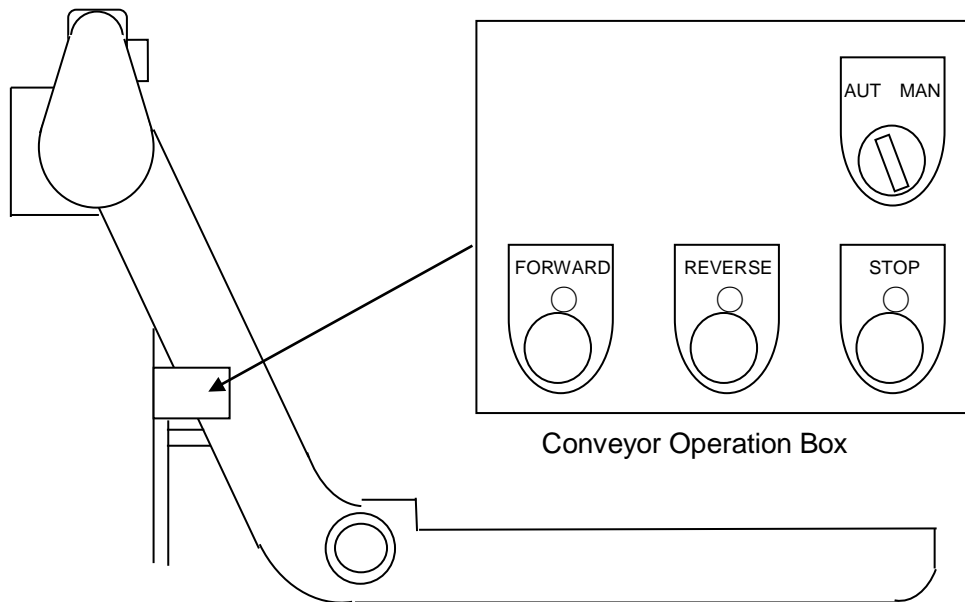
Note 5: Until executing other M250-253, the AICC level changed by M250-253 is kept even if the machine power is turned off.

APPENDIX IV OUTSIDE CHIP CONVEYOR

APPENDIX IV

OUTSIDE CHIP CONVEYOR

(The details of Outside chip conveyor differ depending on the type.)



This outside chip conveyor operates only when NC Ready lamp (58) is lit on and the front doors of the machine are closed. The outside chip conveyor automatically starts operation when programs are executed in MDI or AUTO mode. If the front doors are opened during operation, the outside chip conveyor will stop; it will begin to move again when the doors are closed.



The chip conveyor may start moving suddenly depending on specification. Be sure to turn the main machine off before carrying out maintenance work on the chip conveyor.

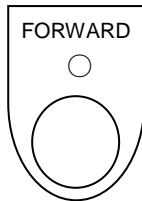
To run Outside chip conveyor manually, the following pushbuttons and switch are available on the conveyor operation box.

APPENDIX IV OUTSIDE CHIP CONVEYOR

Appellation

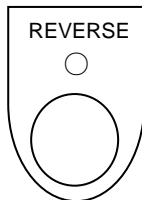
Function

Outside Chip Conveyor Forward Pushbutton (with lamp)



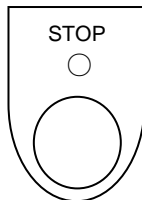
By pressing this button, Outside chip conveyor starts to run forward. During forward running, the lamp is lit on.

Outside Chip Conveyor Reverse Pushbutton



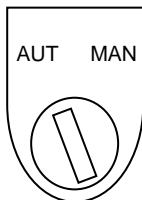
By keeping this button pressed, Outside chip conveyor runs in reverse.

Outside Chip Conveyor Stop Pushbutton



By pressing this button, Outside chip conveyor stops. This button is effective in both AUT and MAN modes (see below).

Outside Chip Conveyor AUT/MAN Select Switch

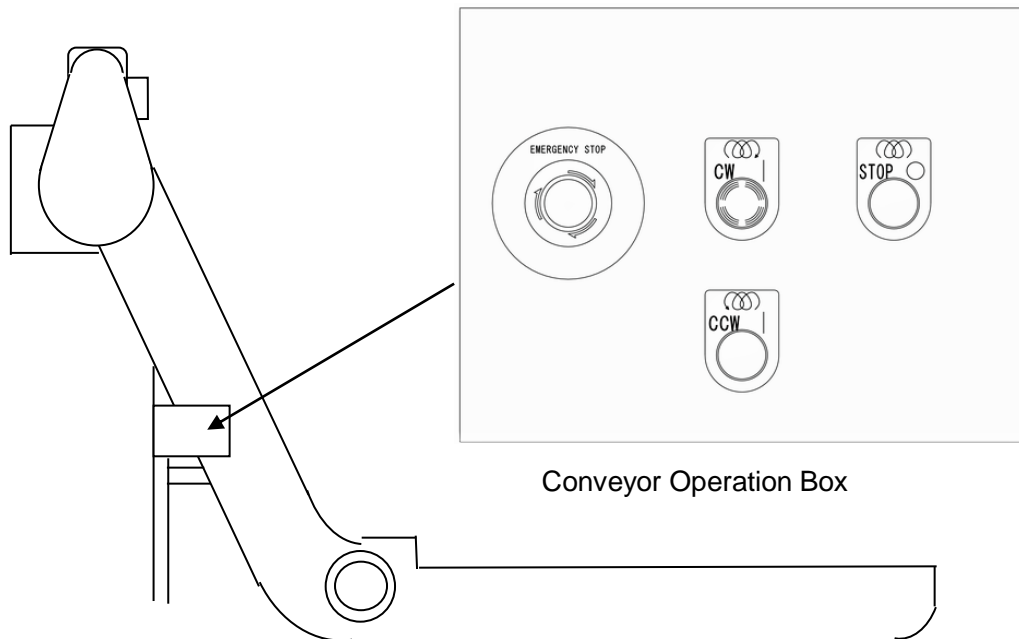


AUT: When the front doors are closed, Outside chip conveyor runs automatically.

MAN: When the front doors are closed, Outside chip conveyor can be driven by pressing Outside chip conveyor Forward pushbutton or Outside chip conveyor Reverse pushbutton.

APPENDIX IV OUTSIDE CHIP CONVEYOR

(for CE)



This outside chip conveyor operates only when NC Ready lamp (58) is lit on and the front doors of the machine are closed. The outside chip conveyor automatically starts operation when programs are executed in MDI or AUTO mode. If the front doors are opened during operation, the outside chip conveyor will stop; it will begin to move again when the doors are closed.



The chip conveyor may start moving suddenly depending on specification. Be sure to turn the main machine off before carrying out maintenance work on the chip conveyor.

To run Outside chip conveyor manually, the following pushbuttons and switch are available on the conveyor operation box.

APPENDIX IV OUTSIDE CHIP CONVEYOR

Appellation

Function

Outside Chip Conveyor Forward Pushbutton (with lamp)



By pressing this button, Outside chip conveyor starts to run forward. During forward running, the lamp is lit on.

Outside Chip Conveyor Reverse Pushbutton



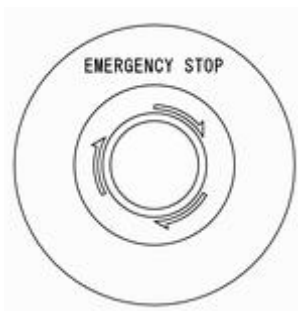
By keeping this button pressed, Outside chip conveyor runs in reverse.

Outside Chip Conveyor Stop Pushbutton



By pressing this button, Outside chip conveyor stops.

Emergency Stop Pushbutton



Pressing this pushbutton stops the machine as well as the chip conveyor.

(The same function as the machine's Emergency Stop Pushbuttons.)

APPENDIX IV OUTSIDE CHIP CONVEYOR

Alarms

If excessive current is detected on the conveyor motor, or if the conveyor does not move for a certain amount of time when the conveyor motor is ON, Outside chip conveyor alarm (message No. 2100) will be given.

Note: Be sure to press Emergency stop pushbutton before checking and removing the cause of the alarm.

In the event of over current on the motor, the reset switch on the thermal relay pushbutton inside the conveyor operation box comes out. After removing the cause of the trouble, press this reset switch, then NC Ready pushbutton to bring the machine back to its normal condition.

O. INSTALLATION

O. INSTALLATION

O-1 Environment

For long life with accuracy of the machine, select an installation site which satisfies the following conditions.

1. No vibration source, such as press machines near the machine, no roads of heavy traffics, etc. If the machine is unavoidably installed near a vibration source, take appropriate measures against vibration.
2. Ambient temperature and humidity around the machine should be kept at uniform within the following ranges. This largely influences machining accuracy.
Temperature in the factory :17°C ~ 20°C
Humidity in the factory :40~75%
3. Heat source is away from the machine.
4. The machine is not exposed to the direct sunlight.
5. Ambient atmosphere should not include organic or corrosive gas or mist.
6. There should not be much dust or particulate matter around the machine.

O. INSTALLATION

O-2 Foundation

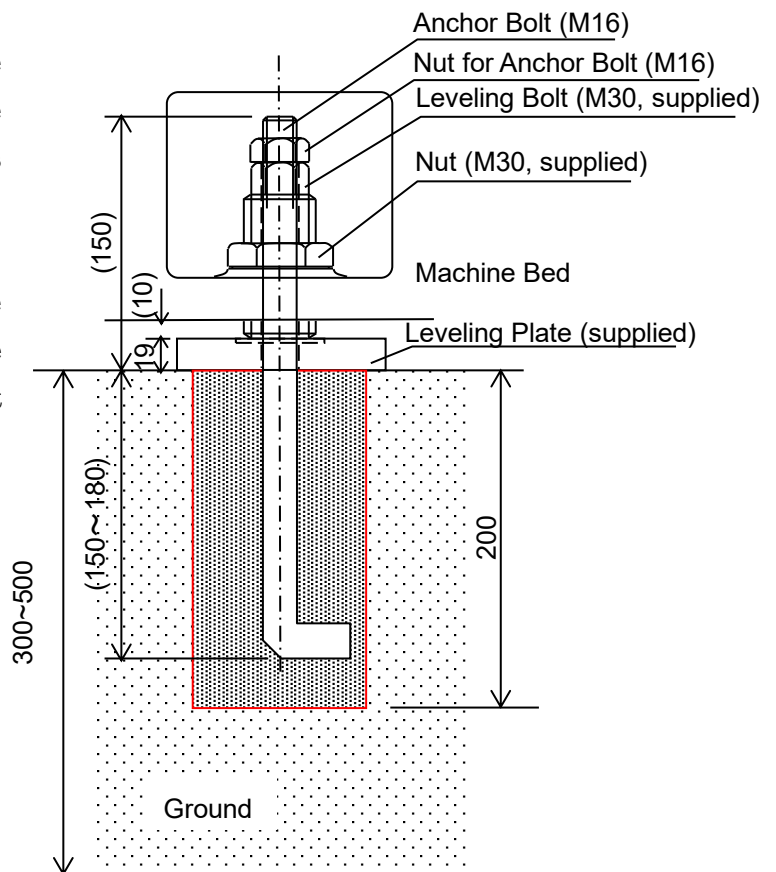
When the ground is strong enough, special foundation work is unnecessary for installation. However, in the following cases, carry out the foundation work as shown on the next page.

1. The ground is weak, and it may cause sinking or inclination of the machine.
2. Higher accuracy and performance are required.
3. High accuracy machining is required for longevity.

Anchoring of the machine

If the machine is a standard one (without 1G option), the machine body won't usually move with axis movements.

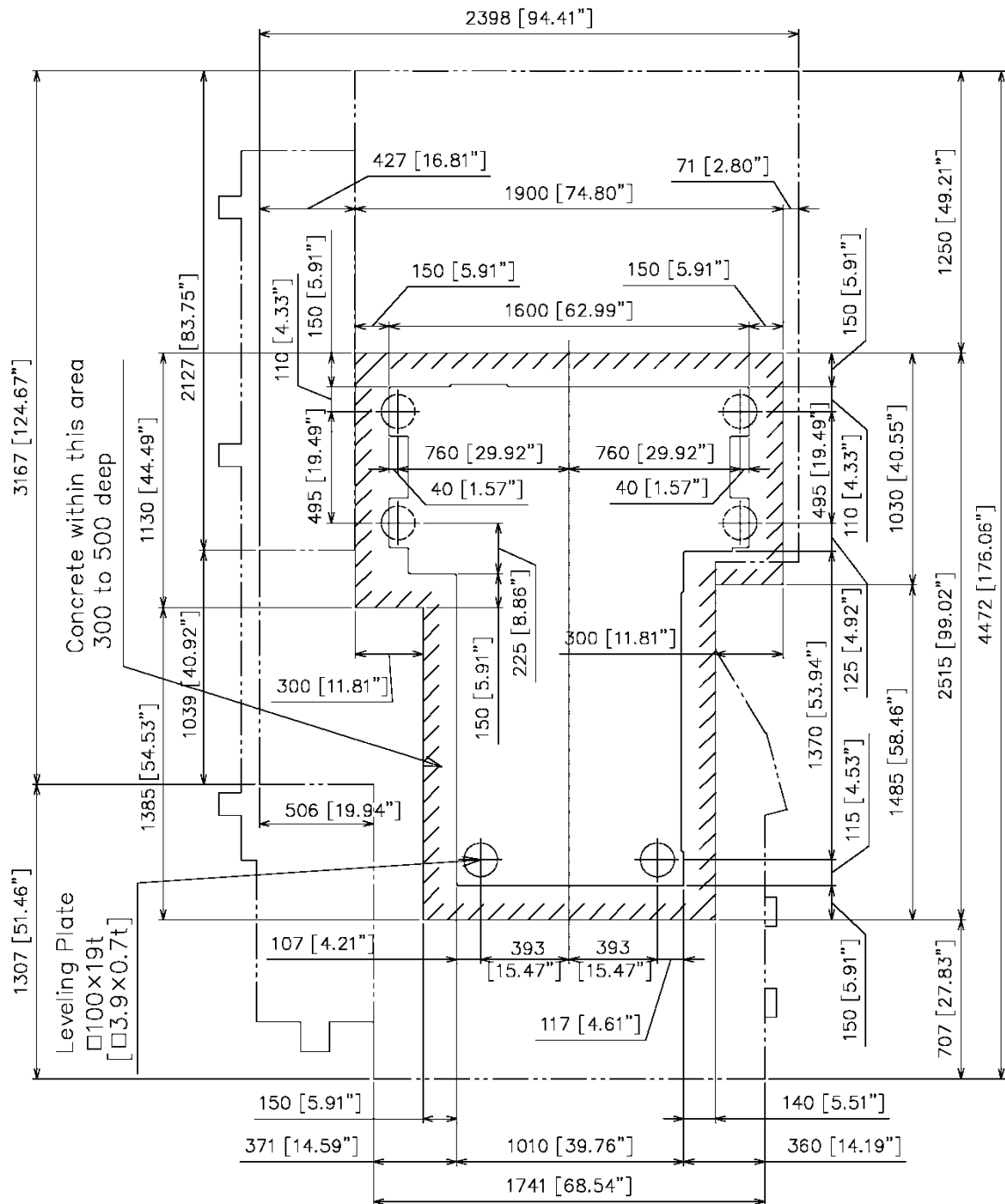
However, if the machine has the 1G option, be sure to anchor the machine to the floor to prevent it from moving with axis movements.



O. INSTALLATION

Foundation Drawing (40/60ATC)

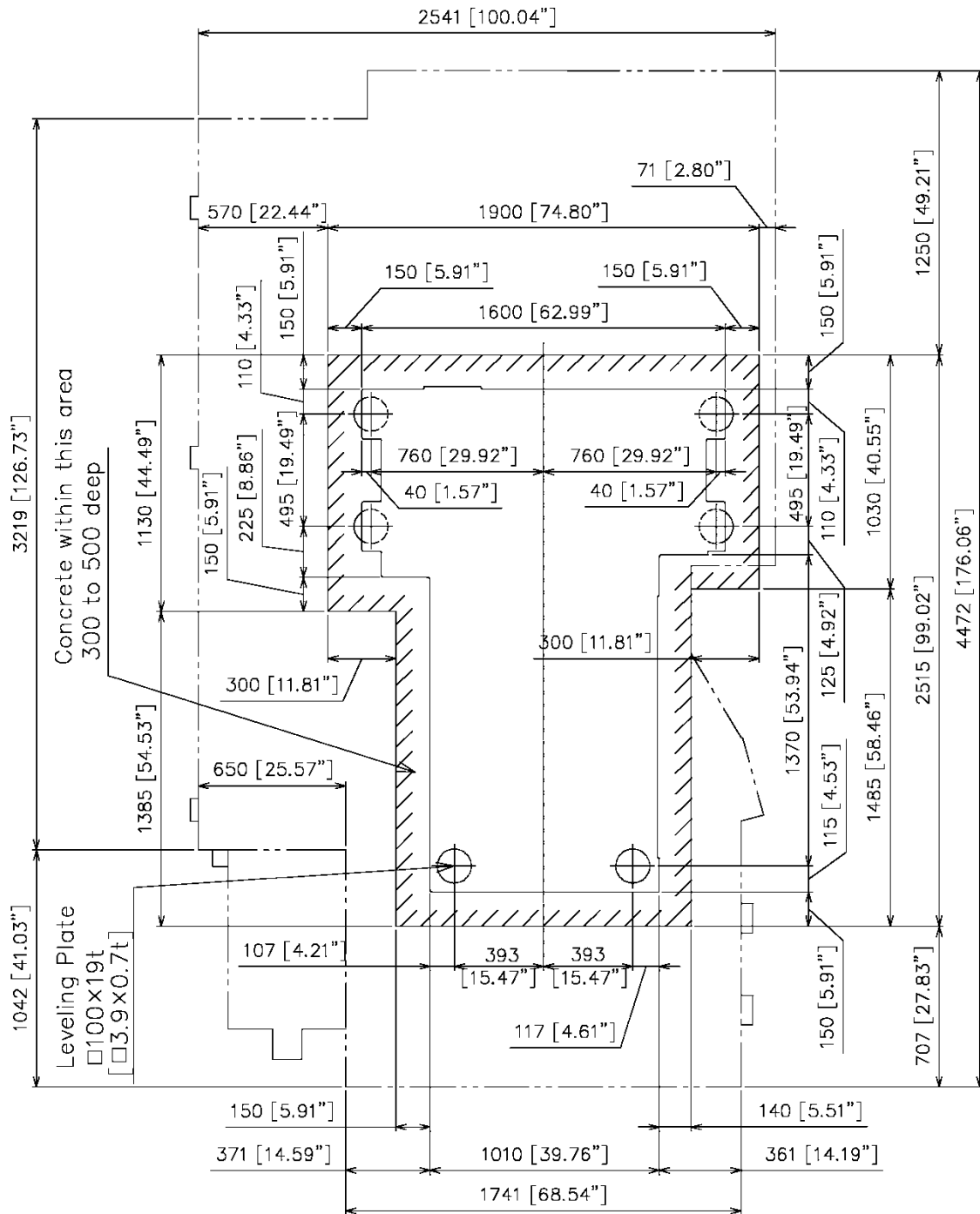
mm [inch]



O. INSTALLATION

Foundation Drawing (80/120ATC)

mm [inch]



O. INSTALLATION

O-3 Hoisting

When hoisting the machine, be sure to hoist/lift the machine as shown on the next page.



- Only qualified personnel are authorized to carry out hoisting, and to use crane or forklift.
- Never go under the lifted machine in any event.



- When a cooperative work is required, determine a chief person whose instructions the other personnel must follow. In this case:
 - Check the safety of the intended work each other.
 - Give signals each other before respective works.
 - Use wire rope, chain, shackle or lifting jig of the specified size without damage, which can sufficiently withstand the machine weight.

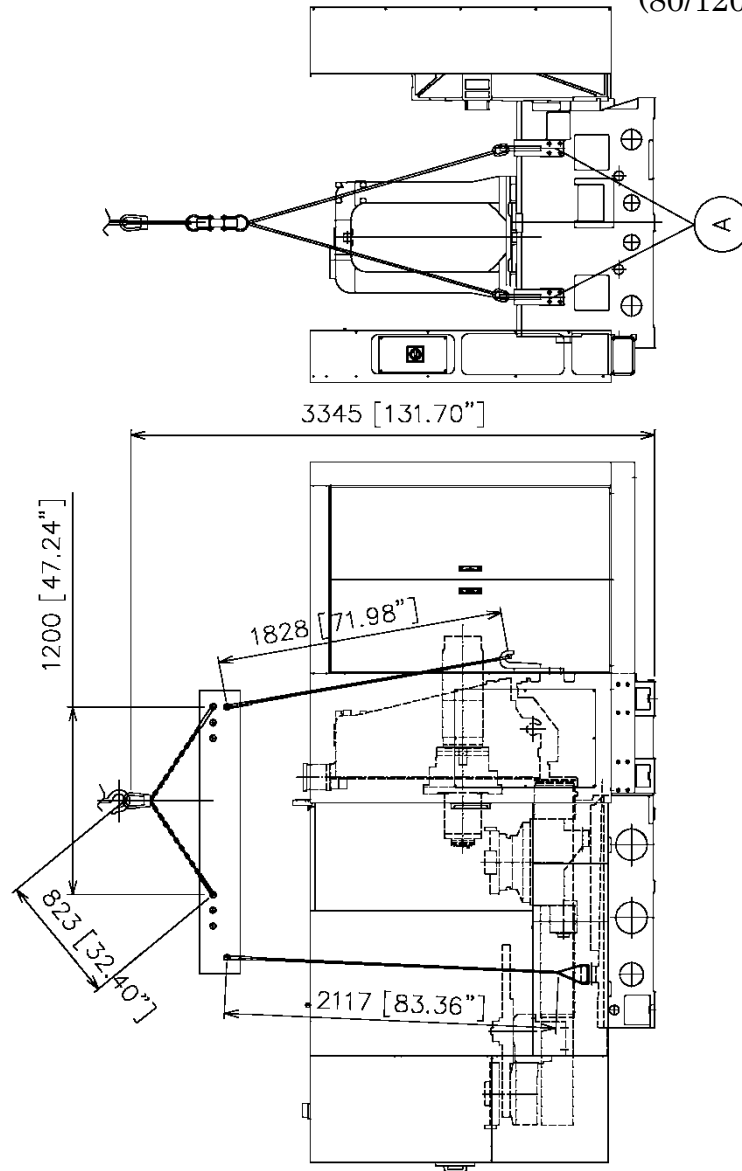
O. INSTALLATION

Hoisting

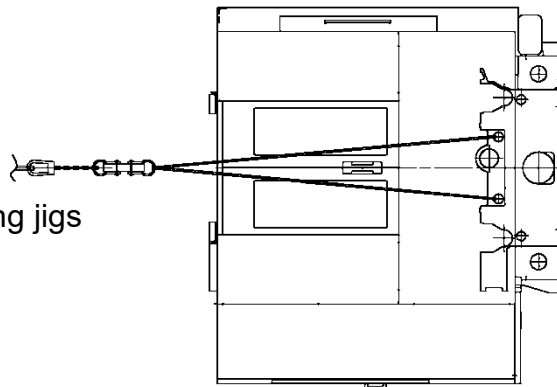
Total weight: 9,100 kg

(80/120ATC: 9,400 kg)

mm [inch]



Remove all the lifting jigs
(A) after putting
the machine down.



O. INSTALLATION

O-4 Unpacking and Cleaning

After unpacking, remove rust preventive applied on the slide covers and metallic sections of the machine, using non-flammable wash oil.

NOTICE

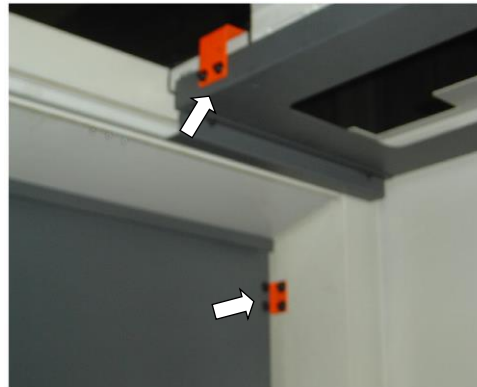
1. The rust preventive agent can get very hard. Please **remove it completely.** Otherwise, it can damage machine parts such as wipers of the slide covers when they move with rust preventive agent left on them.
2. Never use compressed air like air guns for cleaning.

Fixtures for shipment are painted in orange. Please remove all the fixtures at installation, and keep them for future move.

1) Setup Doors and Revolving Door



Machine Front, Left

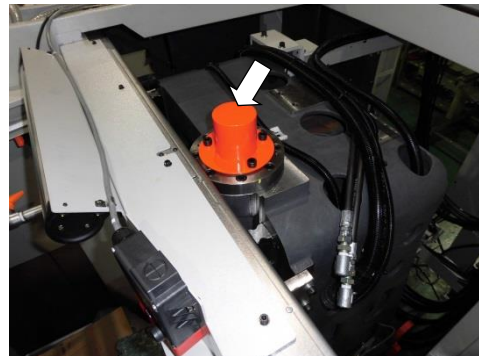


Machine Front, Right

2) Operator Door



Top of Operator Door



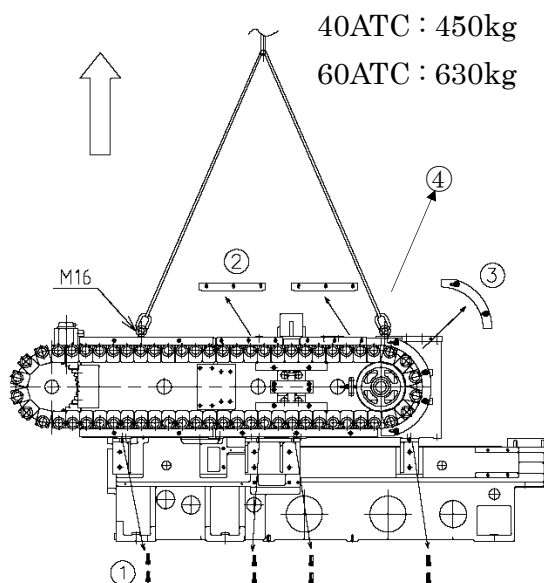
Y axis Cover (Axis Extension)

O. INSTALLATION

O-5 Machine Installation

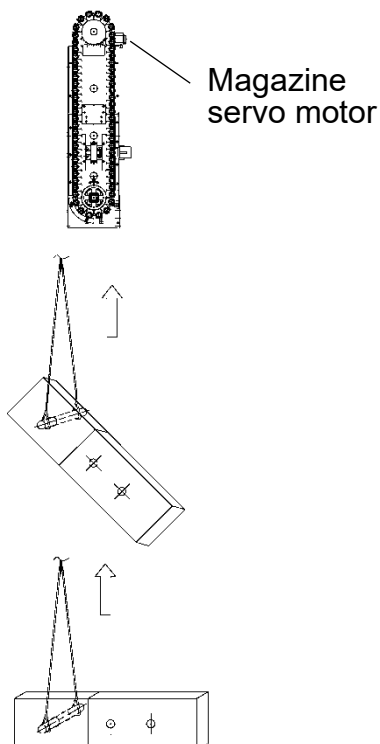
O-5-1 ATC Magazine (40/60ATC only)

At shipment, the ATC magazine is removed and temporarily attached to the machine bed.



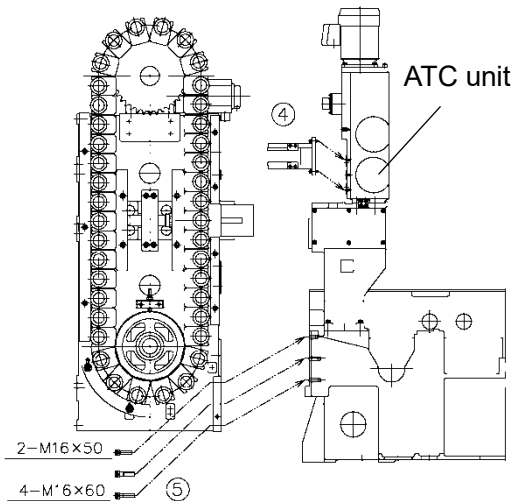
Procedure

1. Remove Tool pot slider (4) that is attached on top of the magazine by a string (see Step 5).
2. Hoisting the magazine, remove eight Bolts (1) from under the magazine, then put the magazine down, and remove the three brackets for transportation from the machine bed.
3. Remove Tool pot guides (2) and (3), three pcs in all, from the magazine (this is for convenience of later work).
4. Put a rod through the hole in the magazine and hoist it in a vertically position with the magazine servo motor on top.

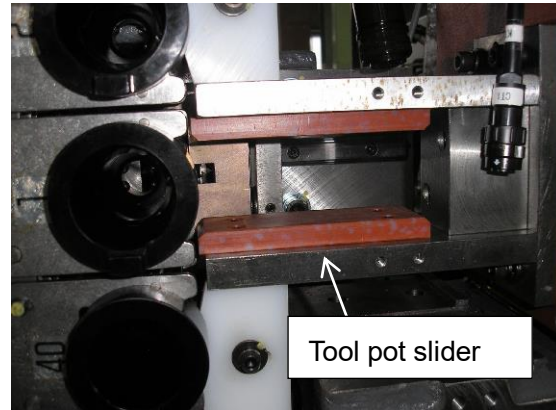


O. INSTALLATION

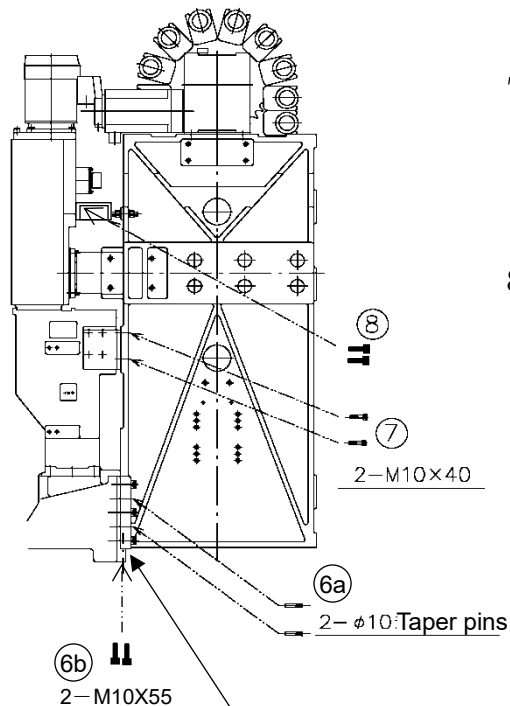
(40/60ATC only)



- Attach Tool pot slider (4) to the ATC unit.



- Put the lower edge of the magazine on the shoulder part of the machine bed and fix it temporarily by two M16x50 bolts and four M16x60 bolts as shown at left (5).



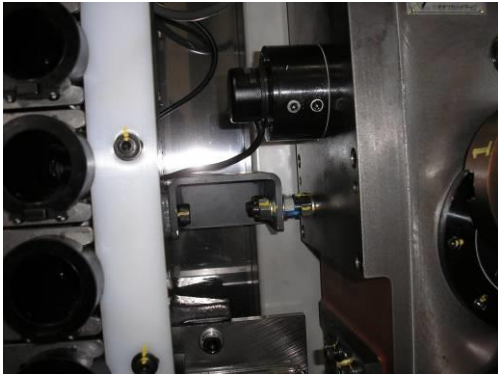
- Insert two Taper pins (6a) and fix the magazine at the bottom by two M10x55 bolts (6b).
- Fix the middle part of the magazine to the machine by two M10x40 bolts (7), as shown on the photo below.



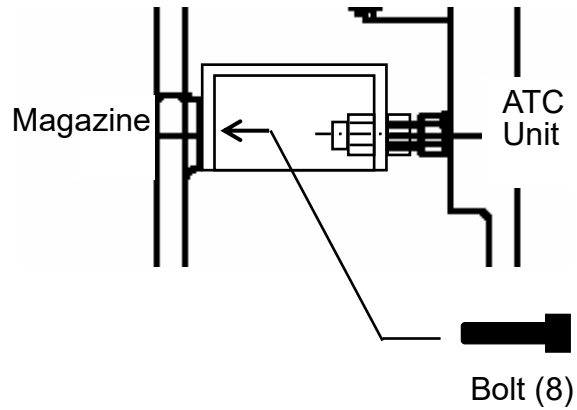
Note: Make sure that there is no clearance between the bottom of the magazine lower edge and the shoulder part of the machine bed.

O. INSTALLATION

(40/60ATC only)



9. Fix the upper part of the magazine to the machine by two bolts (8).



10. Tighten the six M16 bolts (5) finally.

Note: Make sure that there is no clearance between the bottom of the magazine lower edge and the shoulder part of the machine bed.



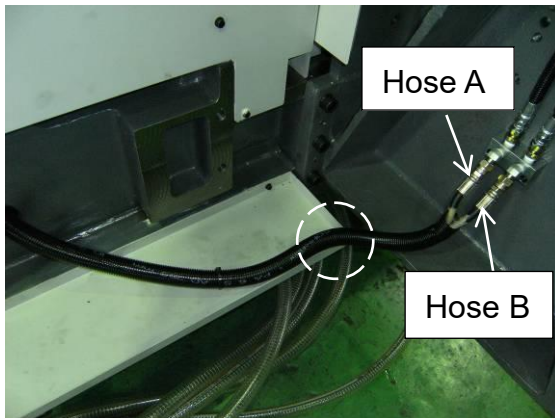
Back of Magazine

11. Introduce the black cable of the cylinder sensors from the back of the magazine to the junction box overhead, through the area at the back of the ATC unit.

O. INSTALLATION

(40/60ATC only)

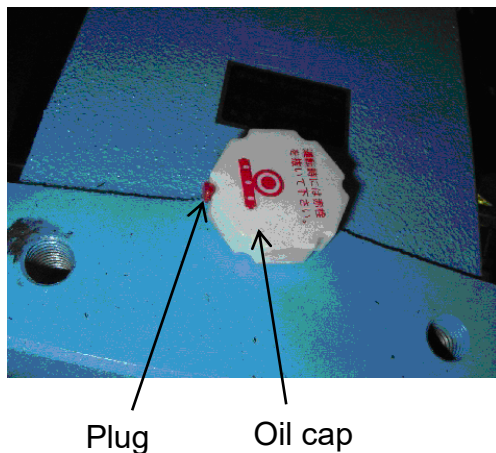
12. Connect the power/signal cables (hanging from the top of the X-axis slide cover at shipment) to the magazine servo motor.



13. Connect the hydraulic hoses for the pot sliding cylinder (coming from the hole on the side wall of the bed, near its back) to the fittings at the back of the magazine.

Note: Make sure that the hoses are protected by the flexible protector at the edge of the tray (dotted circle at left).

14. Attach Tool pot guides (2) and (3) to the magazine (see Step 3).



15. Remove the plug off the oil cap on the magazine reduction unit.

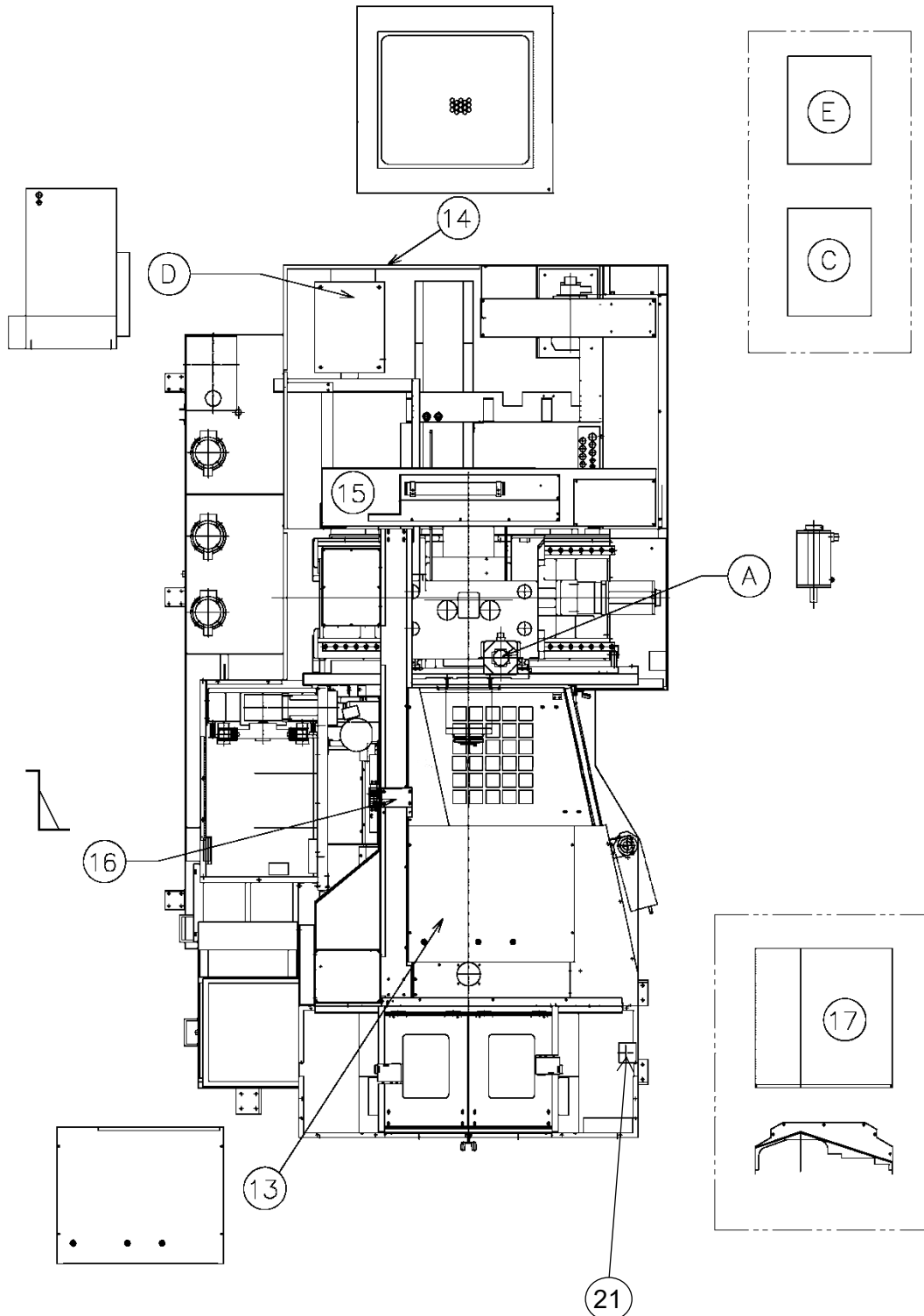
Note: Zero point setting of the magazine is necessary. After installation of the machine, please perform Zero point setting according to Section U-3 “Reset of Reference Point of ATC Magazine” in this manual.

O. INSTALLATION

O-5-2 Mounting of Parts

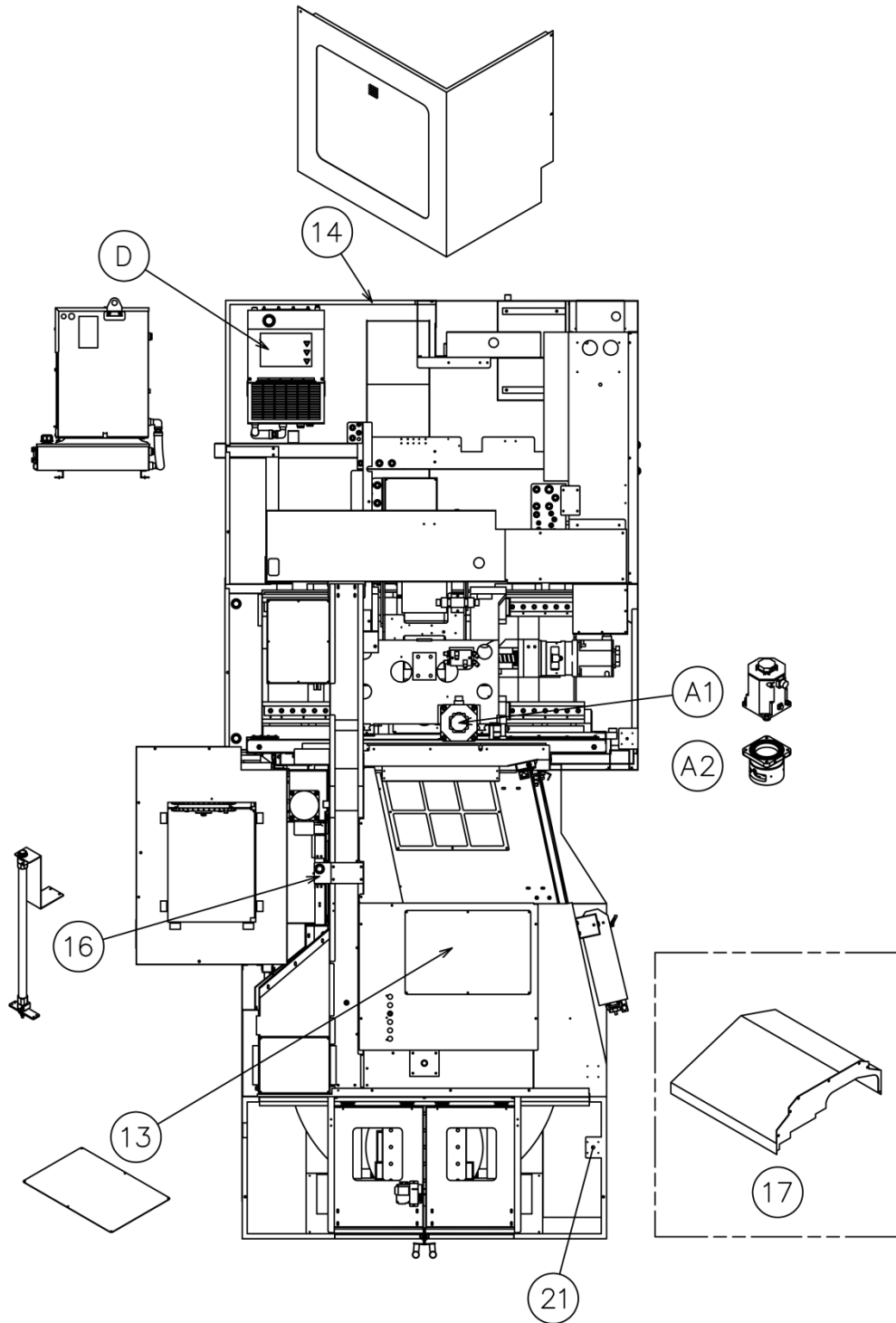
Mount the parts shown below (removed for shipment) according to the instructions on the following pages.

(Standard)



O. INSTALLATION

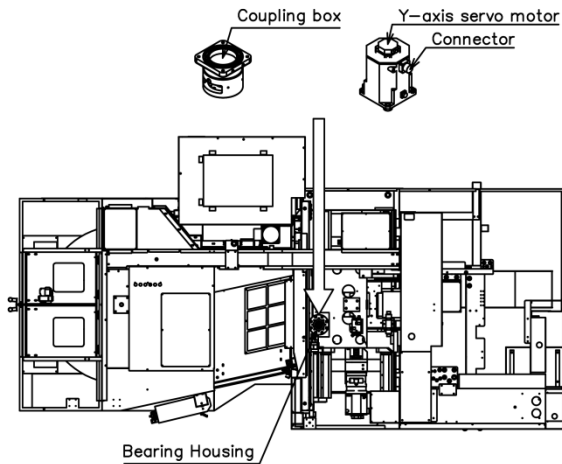
(Axis Extension)



O. INSTALLATION

Y-axis Servo Motor

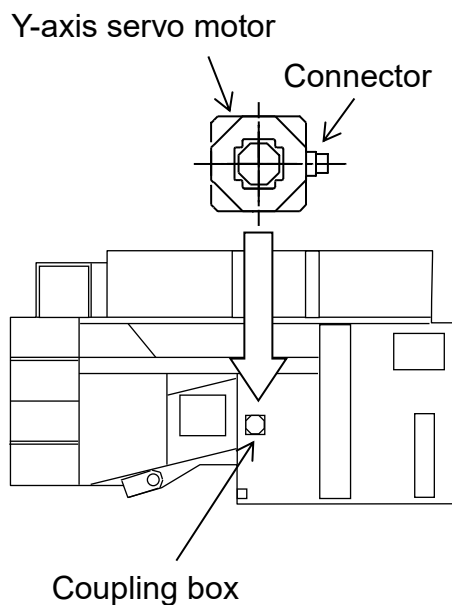
The Y-axis servo motor is removed and separately packed at shipment; the coupling is attached to the motor shaft.



Set the Y-axis coupling box on the Y-axis bearing housing.

There are two plugged tapped holes or two fittings on the flange part of the coupling box. Make sure that side of the flange comes at the rear, and connect the two hoses to these fittings if any.

(Axis Extension Only)



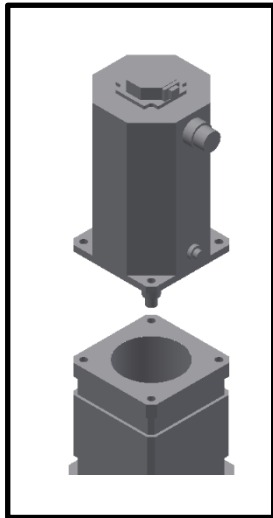
1. Set the servo motor on the Y-axis coupling box of the machine with its connector facing the rear.

(If the machine has a spindle oil chiller, oil will be circulated in the Y-axis coupling box. In this case, please check that there are two O-rings put between the servo motor and the coupling box.)

2. Fix the servo motor to the coupling box tightly with the four bolts.

O. INSTALLATION

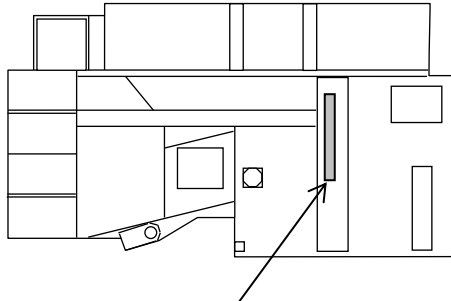
3. Fasten the coupling on the ball screw of the Y axis through the openings at the bottom of the coupling box (fastening torque : 24.8 Nm).
4. Connect the cables (Power, Signal and Brake) to the servo motor.



Note: Because the cables have been removed, the Y-axis positioning data are lost. Be sure to set the mechanical zero point on the Y axis according to Section O-5-8 “Adjustment of Mechanical Zero Point” of this chapter after turning the power on.

O. INSTALLATION

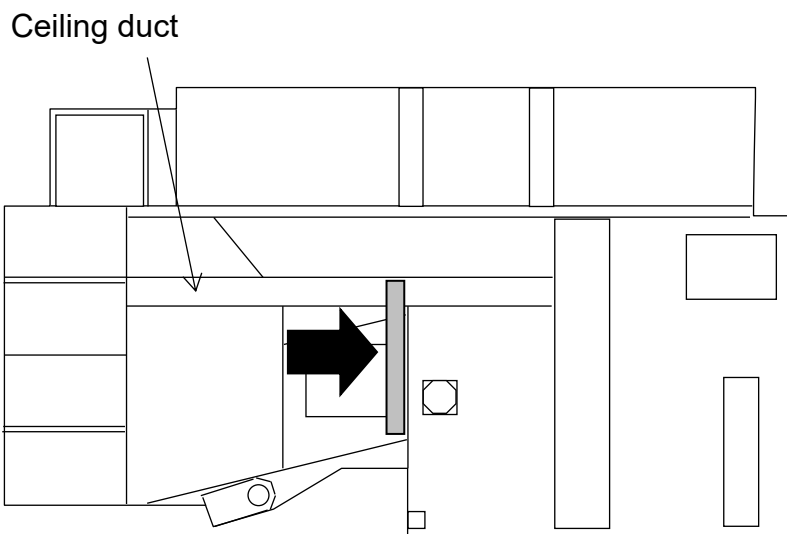
Fluorescent Light (15)



Location at shipment

The body of the fluorescent light is put on the rear part of the machine roof at shipment (but the cable is not disconnected).

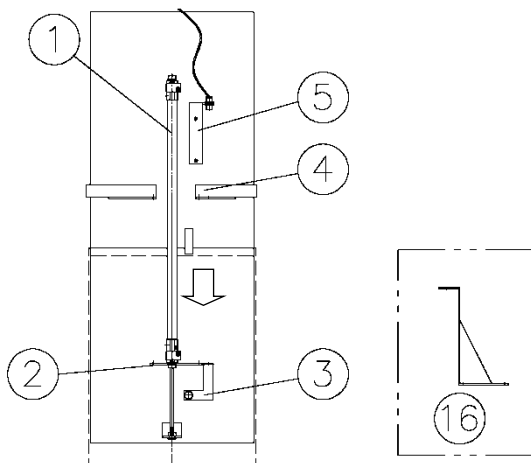
Mount the plate with the fluorescent light to the beam above the X-axis slide cover of the machine (the notch of the plate meeting the ceiling duct).



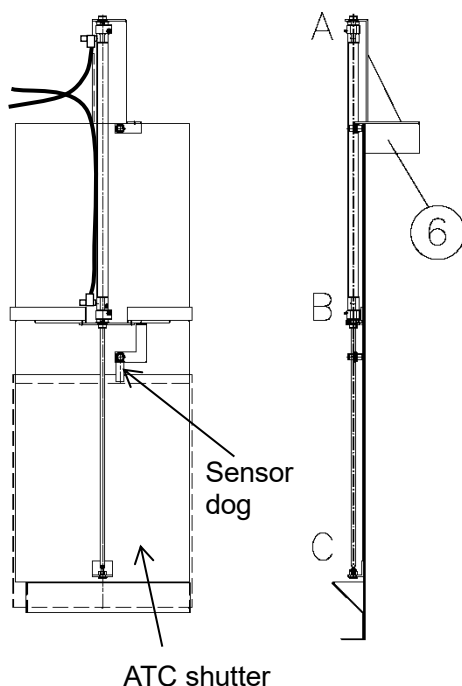
O. INSTALLATION

ATC Shutter Cylinder Bracket (16)

The ATC shutter cylinder (1), Stay (2) and Sensors (3) and (5) are removed and put around the ATC shutter at shipment.



1. Mount Upper cylinder bracket (16) on Ceiling duct (6) of the machine
2. Attach the rod end of Cylinder (1) to the ATC shutter.
3. Extend Cylinder (1) putting its upper end through the hole of Upper cylinder bracket (16), and fix Stay (2) to Bracket (4) by four bolts.



4. Fix the upper end of Cylinder (1) to Upper cylinder bracket (16) by the hexagon nut (attached to the cylinder at shipment).

Note: Pay attention to the alignment of three points A, B and C.

5. Fix Lower sensor (3) and Upper sensor (5) to the machine so that the sensor dog of the ATC shutter will come close (gap of about 1 mm) to each Sensor when the ATC shutter is opened and closed.

6. Connect the air hoses to Cylinder (1).

O. INSTALLATION

Top Cover (13)

Mount the top cover (13) for the machining area.

Connect the hoses to the nozzles on the top cover (13).

Z-axis Slide Cover (17)

Mount the Z-axis upper slide cover (17) on top of the lower slide cover, and fix it to the base of the B-axis rotary table.

Spindle Oil Chiller (D) [Option]

Put the spindle oil chiller (D) [Option] in the back of the machine and connect its hoses (no need to consider flow directions of oil) and cables.

Machine Rear Corner Covers (14)

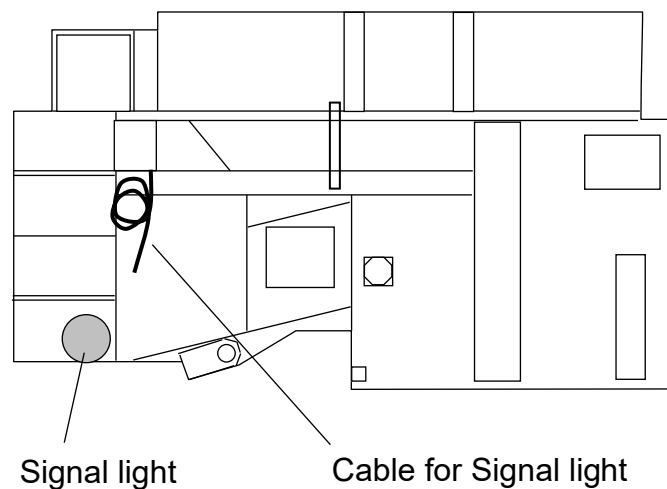
Mount the machine rear corner covers (14).

Note: Please refer to the photo on the next page.

Signal Light (21)

Mount the signal light (21) on the bracket with four bolts, and connect the cable (see below) to the signal light.

Note: Be careful of the cable; it should not be stuck when you open/close the machine front door.



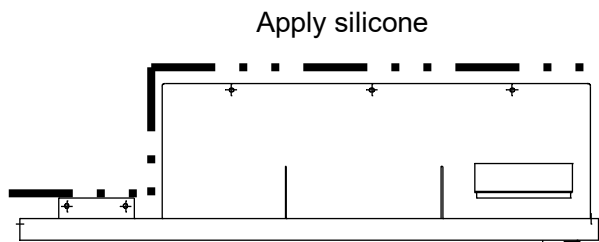
O. INSTALLATION

ATC Magazine Cover

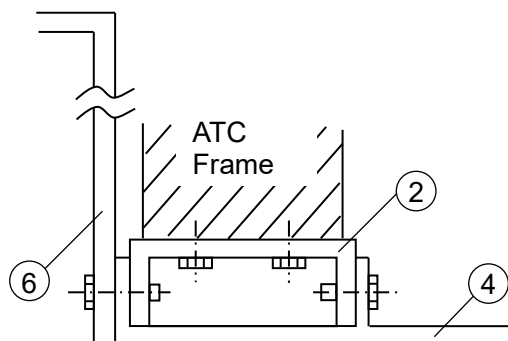
(40/60ATC)

Assemble the ATC magazine cover in the following way (refer to the drawing on the next page):

1. Attach Bottom cover (1). At this moment, apply silicone glue on the cover.



2. Attach Side covers (2) to (4).

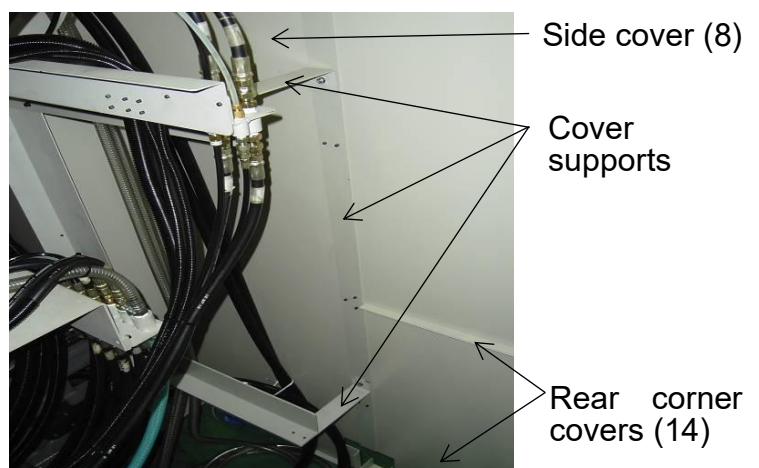


Note: This is an opening for coolant/chips to drop. Do not plug this opening.

3. Attach Magazine door (5).

4. Attach Side covers (6) to (8).

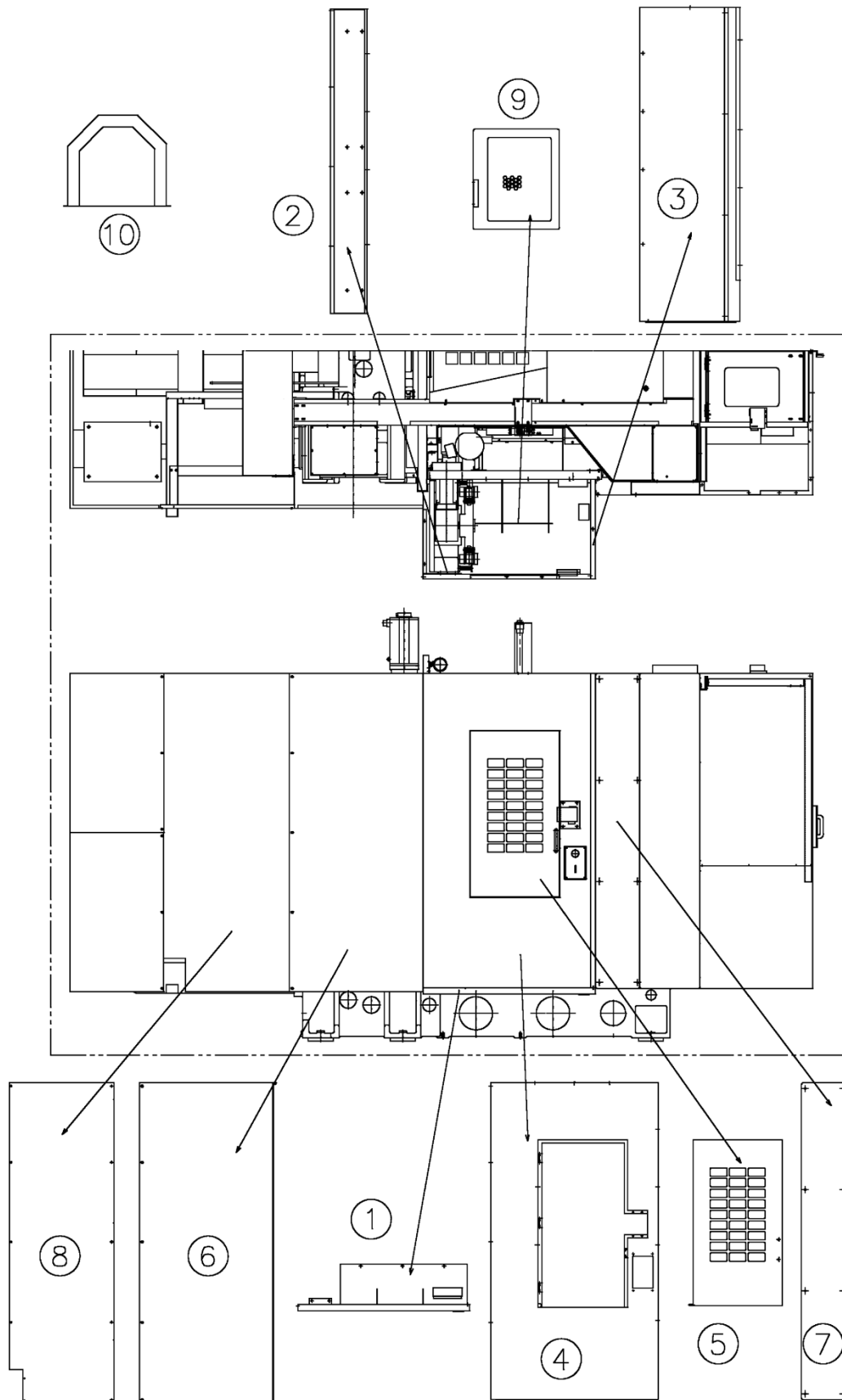
Note: Before attaching the side cover (8), attach the cover supports (removed at shipment).



5. Attach Safety cover (9) inside.

6. Attach Top cover (10) on top of the magazine.

O. INSTALLATION



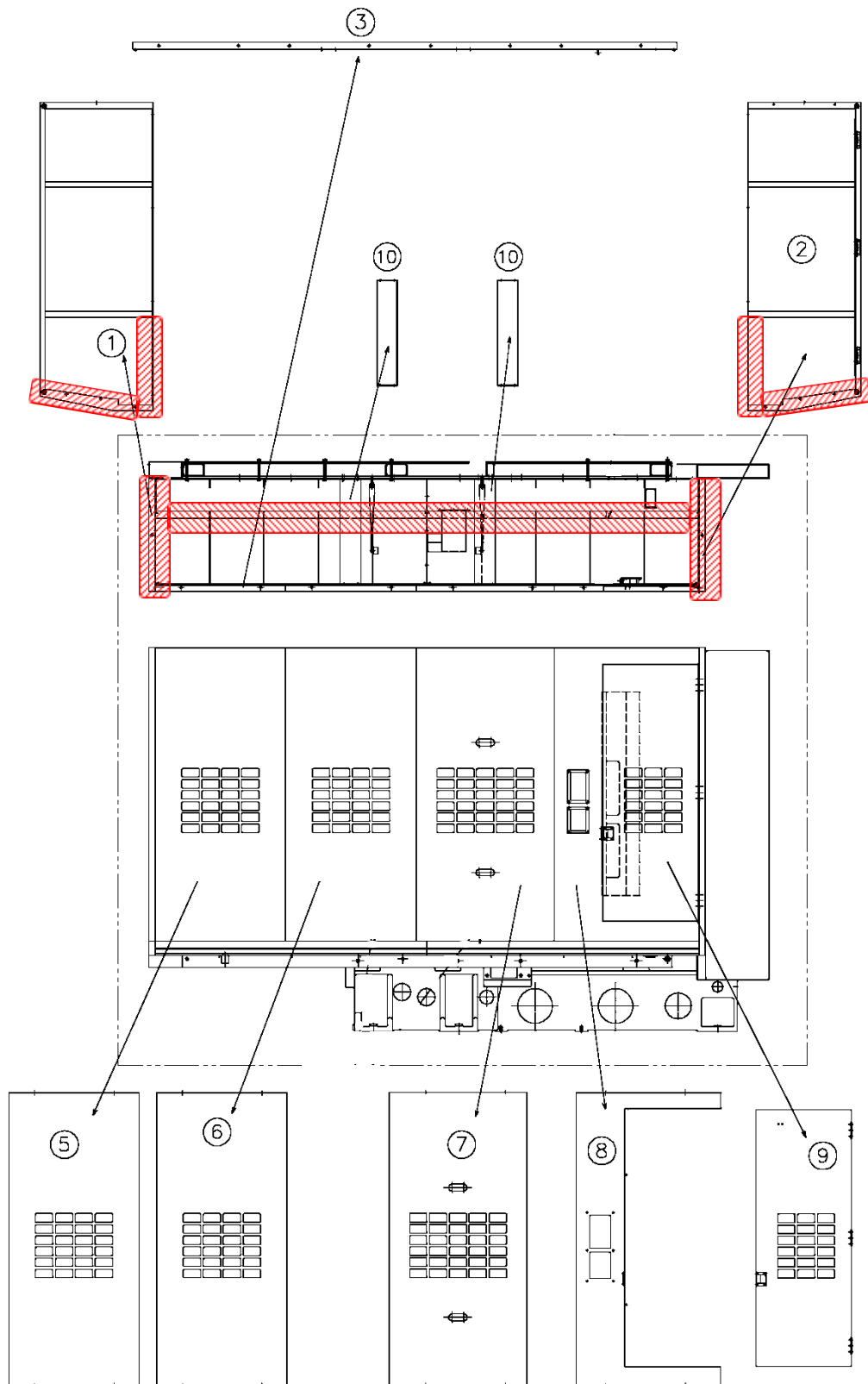
O. INSTALLATION

(80/120ATC)

Assemble the ATC magazine cover in the following way (refer to the drawing on the next page) :

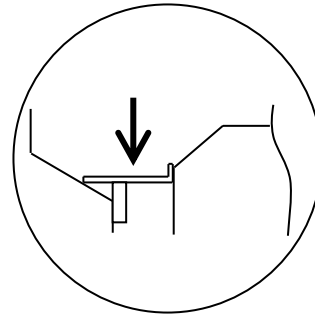
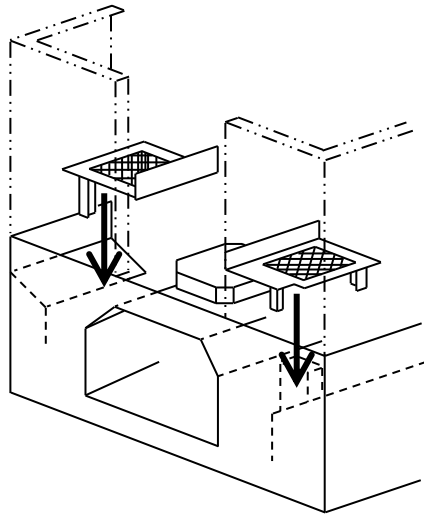
1. Unfold the magazine bottom cover.
2. Attach Side covers (1) and (2), and inserting their lower joints to the pipe of the bottom cover, fix them.
3. Apply silicone glue on the hatched areas of the bottom cover and side covers (1) and (2) as indicated on the drawing.
4. Attach Pipe (3) to the upper joints of Side covers (1) and (2) and fix it.
5. Mount Covers (5) to (8).
6. Mount Door (9) with hinges.
7. Mount two Stabilizers (10) on top.
8. Attach the ATC manual operation switches to the cover (8), and fix their cables to the magazine cover.

O. INSTALLATION



O. INSTALLATION

Safety Nets



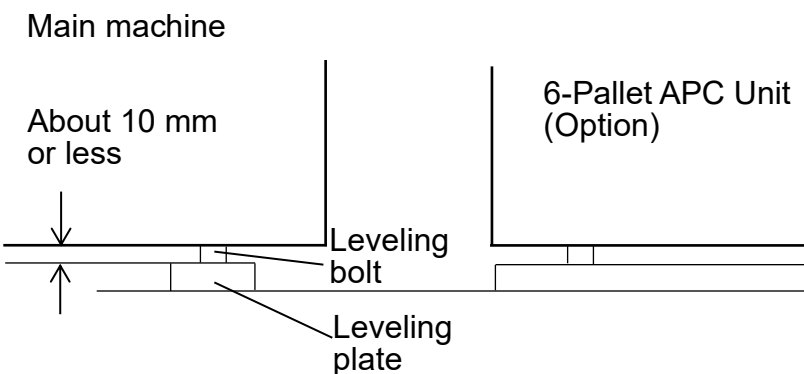
There are two nets provided for prevention of matters from falling into the coolant tank.

Put the two nets in the front of the machine.

O-5-3 Leveling of Machine

Put a level on the pallet inside the machine, and level the machine by the six leveling bolts.

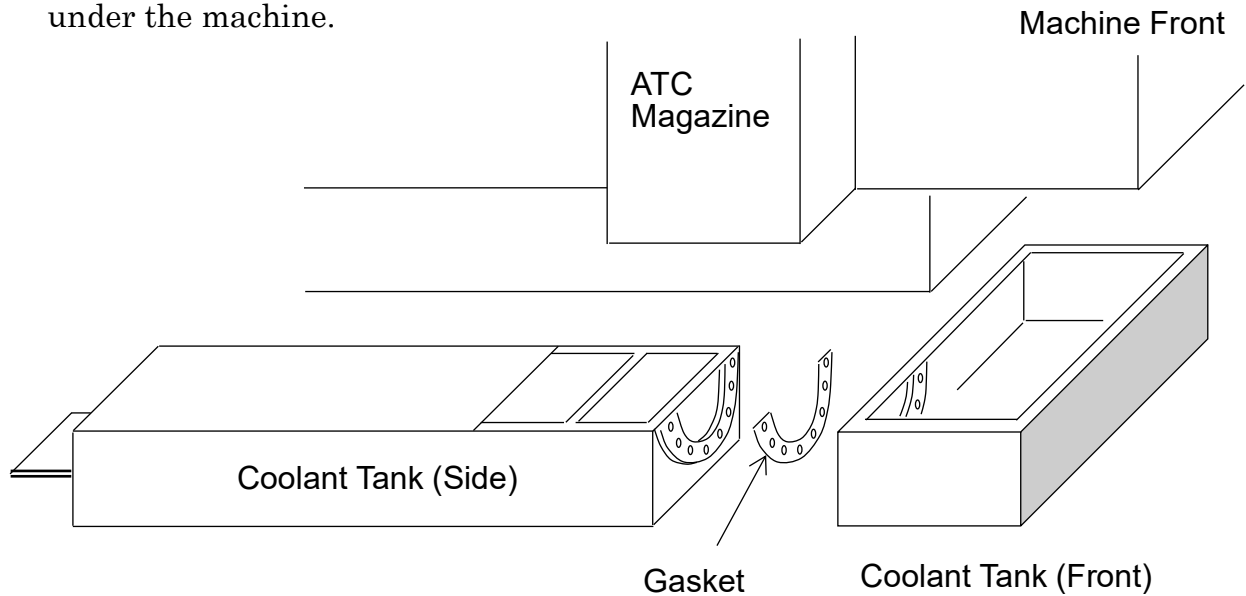
Note: If the machine is installed with a 6-Pallet APC Unit, be sure to keep the indicated dimension about 10 mm or less.



O. INSTALLATION

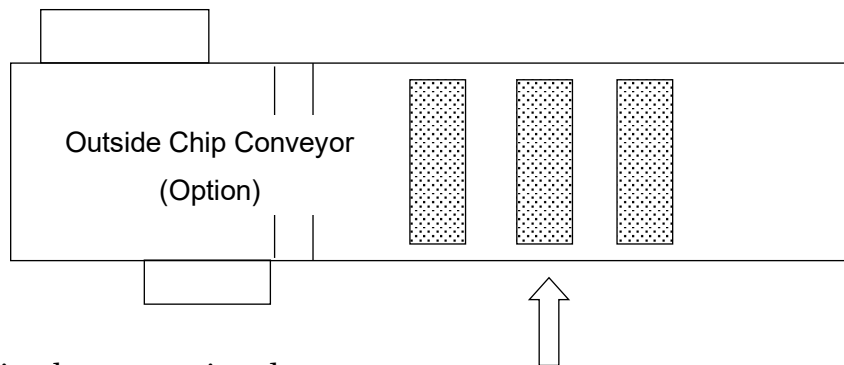
Coolant Tank

Connect Coolant tank (Front) and Coolant tank (Side) by bolts and nuts inserting Gasket between the two tanks, then put it under the machine.



Note: Check for any leak between the two tanks after filling coolant fluid.

Additional Cover for Outside Chip Conveyor



If the machine has an optional scraper type outside chip conveyor, mount the additional splash cover (supplied) on the chip conveyor. Please pay attention to the direction of the splash cover.

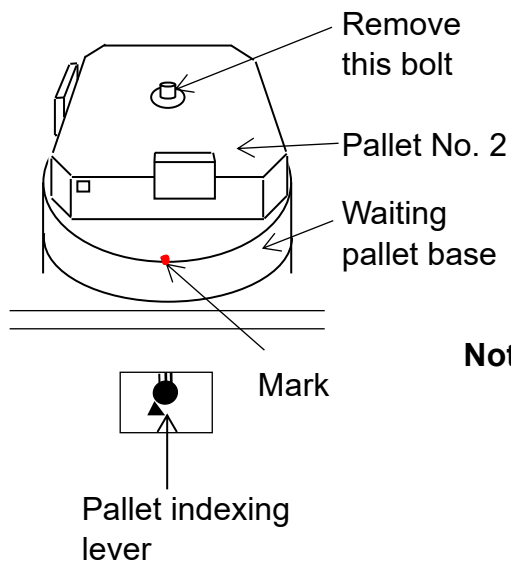


Note: This splash cover is not necessary on 6/8-pallet machines.

O. INSTALLATION

O-5-4 Pallet Setting

At shipment, the pallet No. 2 is fixed on the waiting pallet base of the setup station.



Be sure to remove the bolt at the center of the pallet before operation.

Check that the edge locators of the pallet are positioned as shown on the illustration at left, with the red mark of the waiting pallet base being in front.

Note: On this machine, the pallet numbers are not checked by identifying the pallets themselves; they are only checked by the position of the pallet changing arms. If you remove the pallets from the machine, be sure to put each pallet back to the original location.



- When you turn the pallet (400 x 400 mm) by hand, keep your hands off the protection disk of the pallet. Otherwise your fingers may be caught between the disk and pallet changing arms.
- Moreover, do not apply force on the protection disk. If the protection disk is bent, it will collide with the pallet changing arms.

O-5-5 Electric Wiring and Power Connection



- Only qualified personnel are authorized to carry out power connection and grounding work.
- To prevent other people from turning power on by mistake during connection, put a warning tag or placard such as DO NOT TURN POWER ON at a prominent place.

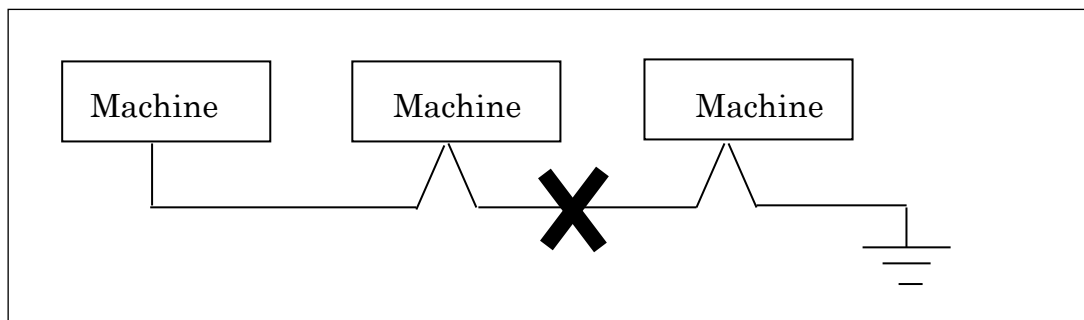
O. INSTALLATION

Use the following primary power source and cables.

- Power voltage
200V 3 phase (50 or 60Hz)
- Cables [from the primary power source to the main power switch of the machine]
Cable with sectional area of 22 mm² or larger recommended (50KVA).
- Transformer
If different power voltages are in service in your country, a proper transformer must be provided. Insert the transformer between the machine and the main.



- **Use one grounding conductor to one machine. Never connect ground cables like below, or a serious accident can be caused.**



Note: After wiring, be sure to check the phase by a phase checker.

O-5-6 Air Source

Air source must be above 0.4 MPa (4 kgf/cm²), 360 N lit./min.

Make sure to use clean dry air; air containing too much dust or damp may make the machine life very short.

O. INSTALLATION

O-5-7 Fixtures for Transportation

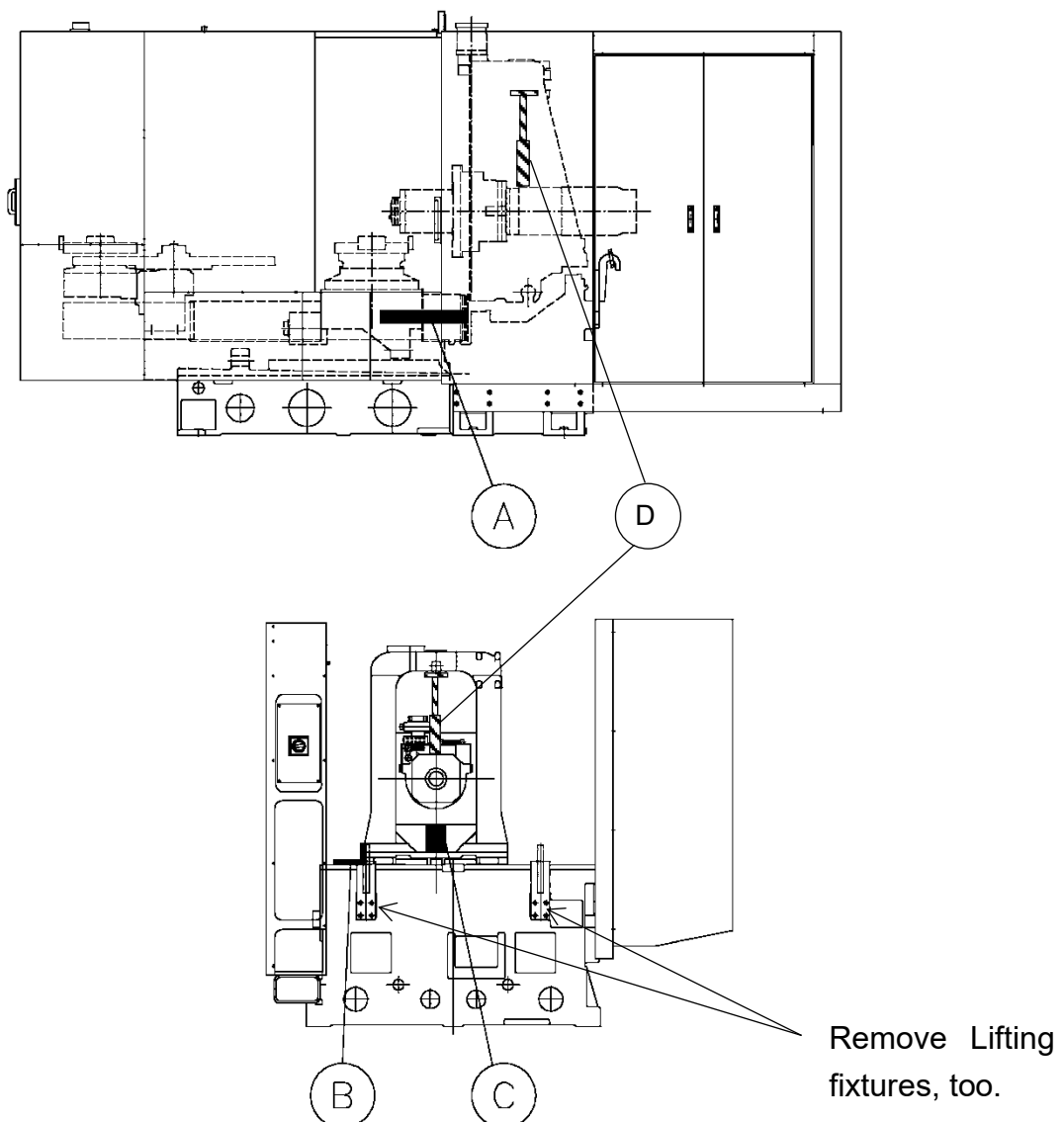
At delivery, fixtures are set for transportation.

Be sure to remove the fixtures (A) to (D) shown in the illustrations below before operation.

Note: Electric power must be turned on when removing the wooden support (C) and prop (D). Please refer to the Operation manual.

Lifting fixtures shown in Section “O-3” also should be taken off.

Please keep these fixtures for future moving.



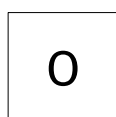
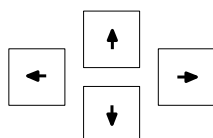
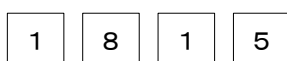
O. INSTALLATION

O-5-8 Adjustment of Mechanical Zero Point (Y Axis)

At delivery, Y-axis servo motor is taken off. After installation, adjust Y-axis Zero Point prior to operation.

Procedure

1. In MDI Mode, press [OFS/SET] key to show Setting data display. Change "PARAMETER WRITE" to "1" from "0". (Ref. U-1)
2. Press Function key [SYSTEM] and Soft key (PARAM).
3. To search Parameter No.1815, press Numerical keys [1] [8] [1] [5] and Soft key (NO SRH). The cursor moves to Parameter No.1815.
4. In order to change Parameter No.1815 Bit 4 to "0" from "1", press the cursor keys to move cursor at APZ of Line Y. Press Numerical key [0] and then [INPUT] key.



PARAMETER (SETTING)					O0000 N0000		
1815	APC APZ						
X	0	0	1	1	0	0	0
Y	0	0	1	1	0	0	0
Z	0	0	1	1	0	0	0

Change this "1" to "0".

P/S Alarm message "Please turn off power." appears.

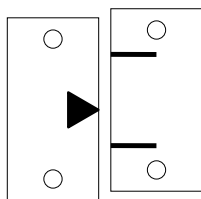
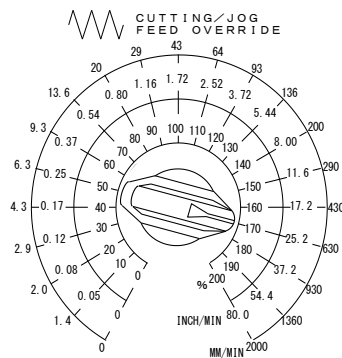
O. INSTALLATION

5. Press [OFS/SET] key to display Setting data screen. Change "PARAMETER WRITE = 0". (Ref. U-1)

Press [RESET] key.

6. Press Emergency Stop pushbutton (61) and NC OFF pushbutton (57) to turn NC power off once. By this procedure, the NC deletes the Y-axis mechanical zero point.

Press NC ON pushbutton (56) to power on NC. Alarm NO.300 [APC Alarm Y axis origin return] occurs. Release Emergency Stop pushbutton (61) and press NC Ready pushbutton (58). Now NC is ready for operation.



7. In JOG mode, set Feed Rate Override and JOG Feed Setting switch (69) at 630mm/min.

8. Press Y-axis Selection pushbutton (26).

9. Press Plus Direction Feed pushbutton (78) until the pointer of the Zero Point plate on the spindle head side gets between the 2 lines of the Zero Point plate on the column side.

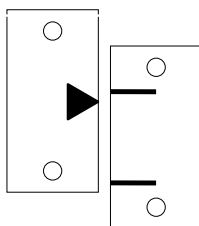
Note: Perform axis traverse in plus direction.

10. Perform Zero point return on Y-axis as below.

Zero Point Return (Y-axis)

Confirm that Y-axis is selected. Press Zero Point Return Mode pushbutton (8), and keep pressing Plus Direction Feed pushbutton (78) until Y axis Zero Point Return completion lamp is lit.

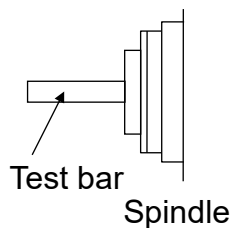
O. INSTALLATION



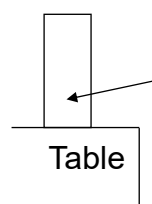
The pointer comes nearly at the upper line of the Zero Point plate on the column side.

Note: Confirm that the Y-axis Zero Point Return Completion lamp (22) is lit.

11. Now temporary Zero Point (Y-axis) is got. From now on, it's necessary to get true Zero Point.



Put Test bar of any diameter onto the spindle. (Here we take Test bar of Dia. 50 mm.) Put Block gauge of any height on the table (Here we take Block gauge of 100 mm high).



12. The amount and direction to move is calculated as below:

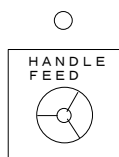
$$Y = (25 + 100) - 660 = - 535$$

(25: Test bar radius, 100: Block gauge height, 660: Y-axis height)

(In case of Axis Extension)

$$Y = (25 + 100) - 790 = - 665$$

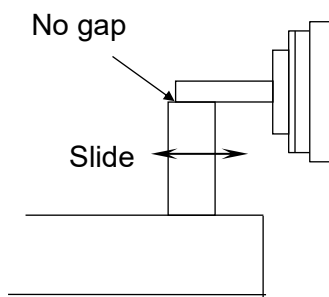
(25: Test bar radius, 100: Block gauge height, 790: Y-axis height with extension)



13. Put Block gauge aside off the test bar. In Handle mode, move Y axis by 535 (in case of Axis Extension: 665) mm in minus direction.

14. Press Soft key (REL) in Position screen. Press Y axis Selection pushbutton (26) then press Soft key (ORIGIN) so that the Y-axis coordinate is set "Y 0.000".

O. INSTALLATION

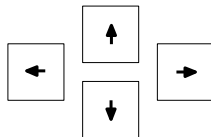


15. With Manual Pulse Generator (Handle feed amount should be $\times 10/0.01\text{mm}$), move Y-axis and find the point where Block gauge slides under the Test bar without gap.

16. Check the relative coordinate. Multiply the data shown as Y-axis coordinate by 1000. Here we suppose "Y 1.010" as the relative coordinate. The amount to be input should be 1010 (1.010×1000).

17. In MDI mode, press [OFS/SET]. Change PARAMETER WRITE to "1 (ENABLE)" (Ref. U-1)
PS/100 Alarm is displayed.

18. Press [SYSTEM] → [PRM] → [1850], (NO SRH) in this order. The Cursor goes to No.1850.



19. Move the cursor to Y-axis.

20. Press [1], [0], [1], [0] and Soft key (+INPUT). The original value at Parameter No.1850 Y-axis changes to the value added 1010 to the original value.

Note: Parameter No.1850 is for "Grid Shift".

The machine Zero Point is shifted by the amount input here. The input value should be the measured data multiplied by 1000.

Usually, the shift amount should be around +/- 10 mm.

O. INSTALLATION

ex.)

Here for example, suppose the original data for Y-axis is “3210”. With cursor keys, move the cursor to Y-axis.

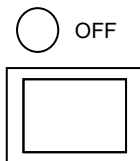
PARAMETER (SETTING)	O0000 N0000
1850	
X	335
Y	3210
Z	-4691

Input “1010” then press Soft key (+ INPUT).
The Y axis data changes to the value added by 1010, that is, “4220”.

PS/000 Alarm appears requesting power off.

21. Press [OFS/SET] key.

22. Change Parameter Write to “0 (DISABLE)”.
Press RESET key.

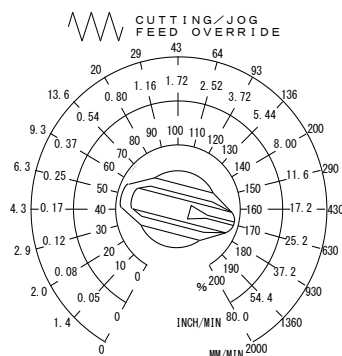


23. Press NC OFF pushbutton **(57)**, to turn power off once.

24. After a few seconds, bring machine in ready status.

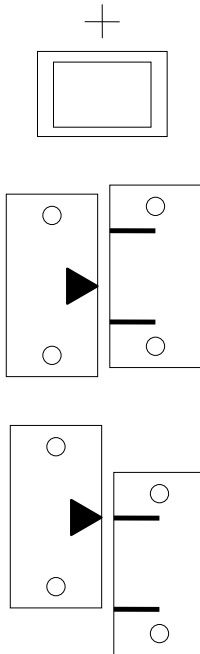
PS/300 Alarm is displayed.

25. In JOG mode, set Feed Rate Override and JOG Feed Setting switch **(69)** at 630mm/min. on the outer scale.



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26. Confirm that the Y axis is selected.



27. Keep pressing Plus Direction Feed pushbutton (78) until the pointer of the Zero Point plate comes around the center of 2 lines of the other Zero Point plate.

28. Perform Zero Point Return on Y-axis in Zero Point Return mode. (Ref. Step 10)

When Y-axis Zero Point Return Completion lamp (22) is lit, check that the machine coordinate of Y-axis is "0R. Also check that the pointer of Zero Point plate is right at the upper line of the other Zero Point plate.

29. For confirmation, check that the Z-axis has the height of 660 (in case of Axis Extension: 790) mm.

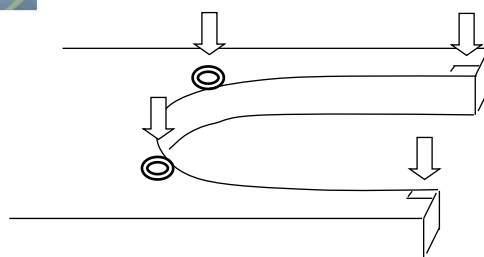
Note: When it doesn't have the correct height, try it again from Step 13.

O. INSTALLATION

Coolant Shower on Pallet Changing Arms



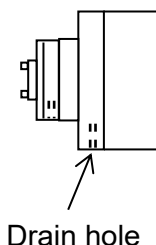
Please check and make sure that coolant from the ceiling nozzles (see the photo at left) is applied on the pallet changing arms to wash the spots indicated by the arrows below. (Some nozzles are pointed at part of the operator door and so on.)



Pallet changing arms

PLEASE READ BEFORE ROTATING THE SPINDLE!

The spindle bearings are lubricated by the oil and air lubrication system together with the ballscrews and linear guides. When you rotate the spindle for the first time after installation, please be sure to follow the steps below:



- 1) After turning power on, put a light tool into the spindle, and press Oil & Air pushbutton on the operation panel to check that small particles of oil are flowing out of the mixing valves (refer to Chapter "R" of this manual).
- 2) Keep the machine in NC ready status until drops of oil come out of the drain hole at the lower part of the spindle nose. It may take about an hour, but pressing Oil & Air pushbutton from time to time will shorten the time.
DO NOT ROTATE SPINDLE BEFORE OIL COMES OUT!
- 3) Rotate the spindle under $1,000 \text{ min}^{-1}$ for more than 20 minutes.
- 4) Perform a spindle warm-up operation.